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ABSTRACT

The guide contains six sections, each consisting of one or more units of general mechanical trades instruction. The sections cover: safety and tools, measuring and blueprint reading, gas welding, arc welding, small engines, and metal work. Each unit includes performance objectives stated as terminal objectives, indicating the subject matter to be covered, and as specific objectives for student performance. All units contain suggested student and teacher activities, information sheets providing the essential content of the unit, tests with answers, and a reference list. Many of the units also have transparency masters, job sheets designed to teach a skill, and assignment sheets to provide paper and pencil activities. Numerous illustrations are included on the assignment and job sheets, tests, and transparency masters. (MS)

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GENERAL MECHANICAL TRADES

A CURRICULUM GUIDE
1971
Revised, 1973

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USE OF THIS PUBLICATION

Instructional Units

General Mechanical Trades curriculum includes six areas. Each area consists of one or more units of instruction. Each instructional unit includes behavioral objectives, suggested activities for teacher and students, information sheets, assignment sheets, job sheets, visual aids, tests, and answers to the test. Units are planned for more than one lesson or class period of instruction.

Careful study of each instructional unit by the teacher will help him determine:

A. The amount of material that can be covered in each class period.
B. The skills which must be demonstrated.
    1. Supplies needed
    2. Equipment needed
    3. Amount of practice needed
    4. Amount of class time needed for demonstrations
C. Supplementary materials such as pamphlets and filmstrips that must be ordered.
D. Resource people that must be contacted.

Objectives

Each unit of instruction is based on behavioral objectives. These objectives state the goals of the course thus providing a sense of direction and accomplishment for the student.

Behavioral objectives are stated in two forms: Terminal Objectives stating the subject matter to be covered in a unit of instruction; Specific Objectives stating the student performance necessary to reach the terminal objective.

Since the objectives of the unit provide direction for the teaching-learning process, it is important for the teacher and students to have a common understanding of the intent of the objectives. A limited number of performance terms have been used in the objectives for this curriculum to assist in promoting the effectiveness of the communication among all individuals using the materials.

Following is a list of performance terms and their synonyms which were used in this material:

Name
Label
List in writing
List orally
Letter
Record
Repeat
Give

Identify
Select
Mark
Point out
Pick out
Choose
Locate

Describe
Define
Discuss in writing
Discuss orally
Interpret
Tell how
Tell what
Explain

Order
Arrange
Sequence
List in order
Classify
Divide
Isolate
Sort

Distinguish
Discriminate

Construct
Draw
Make
Build
Design
Formulate
Reproduce
Transcribe
Reduce
Increase
Figure
Cost

Demonstrate
Show your work
Show procedure
Perform an experiment
Perform the steps
Operate
Remove
Replace
Turn off/on
(Dis) assemble
(Dis) connect

Reading of the objectives by the student should be followed by a class discussion to answer any questions concerning performance requirements for each instructional unit.

Teachers should feel free to add objectives which will fit the material to the needs of his students and community. When a teacher adds objectives, he should remember to supply the needed information, assignment and/or job sheets, and criterion tests.

Suggested Activities

Each unit of instruction has a Suggested Activities sheet outlining steps to follow in accomplishing specific objectives. The activities are listed according to whether they are the responsibility of the instructor or the student.

Instructor: Duties of the instructor will vary according to the particular unit; however, for best use of the material they should include the following: provide students with objective sheet, information sheets, assignment sheets, and job sheets; preview filmstrips, make transparencies, and arrange for resource materials and people; discuss terminal and specific objectives and information sheets; give test. Teachers are encouraged to use any additional instructional activities and teaching methods to aid students in accomplishing the objectives.

Students: Student activities are listed which will help the student to achieve the objectives for the unit.

Information Sheets

Information sheets provide content essential for meeting the cognitive (knowledge) objectives of the unit. The teacher will find that information sheets serve as an excellent guide for presenting the background knowledges necessary to develop the skills specified in the terminal objective.

Students should read the information sheets before the information is discussed in class. Students may take additional notes on the information sheets.

Transparency Masters

Transparency masters provide information in a special way. The students may see as well as hear the material being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information sheets. They are particularly effective for such activities as learning and locating the parts of a machine.

Transparencies should be made and placed in the notebook where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion. They should be left on the screen only when topics shown are under discussion. (NOTE: Stand away from the overhead projector when discussing transparency material. The noise of the projector may cause the teacher to speak too loudly.)

Job Sheets

Job sheets are an important segment of each unit. The instructor should be able to and in most situations should demonstrate the skills outlined in the job sheets. Procedures outlined in the job sheets give direction to the skill being taught and allow both student and teacher to check student progress toward the accomplishment of the skill. Job sheets provide a ready outline for a student to follow if he has missed a demonstration. Job sheets also furnish potential employers with a picture of the skills being taught and the performances he might reasonably expect from a person who has had this training.

Assignment Sheets

Assignment sheets give direction to study and furnish practice for paper and pencil activities to develop the knowledges which are necessary prerequisites to skill development. These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided which may be used by the student and/or teacher for checking student progress.

Test and Evaluation

Paper-pencil and performance tests have been constructed to measure student achievement of each objective listed in the unit of instruction. Individual test items may be pulled out and used as a short test to determine student achievement of a particular objective. This kind of testing may be used as a daily quiz and will help the teacher spot difficulties being encountered by students in their efforts to accomplish the terminal objective. Test items for objectives added by the teacher should be constructed and added to the test. Progress sheets are provided for student and teacher to record acceptable performance of skills outlined in job sheets.

Test Answers

Test answers are provided for each unit. These may be used by the teacher and/or student for checking student achievement of the objectives.

SAFETY
UNIT I

TERMINAL OBJECTIVE

After completion of this unit of instruction, the student should be able to select rules for shop and personal safety and complete a safety inspection checklist. He should be able to select the correct fire extinguisher for the classes of fire and match the safety color code with statements of its use. The student should be willing to sign the safety pledge form and make at least ninety percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match three terms with their definitions.
2. Match the six colors of the safety code with statements of their uses.
3. Select from a list rules for personal safety.
4. Select from a list rules for general shop safety.
5. Select from a list those steps that are necessary to maintain a clean and orderly shop.
6. Match the four classes of fire with statements defining each class.
7. Select from a list of fire extinguishers the types best suited to extinguish each class of fire.
8. Complete a National Standard School Shop Safety Inspection check list.
9. Indicate a willingness to work safely by subscribing to the student safety pledge form.

SAFETY
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with objective sheet.

  B. Provide students with information sheet, safety pledge form, and National Standard School Shop Safety Inspection check list.

  C. Make transparency.

  D. Discuss terminal and specific objectives.

  E. Discuss information sheet.

  F. Give test.

II. Student:

  A. Read objective sheet.

  B. Study information sheet.

  C. Complete the National Standard School Shop Safety Inspection check list.

  D. Complete the safety pledge form.

  E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objective sheet

  B. Information sheet

  C. Transparency master--TM 1--Types of Fire Extinguishers

  D. Safety Pledge

  E. Standard School Shop Safety Inspection Check List

  F. Test

  G. Answers to test

II. References:

A. *The ABC's of Fire Protection.* Kidde Portable Extinguishers, Walter Kidde and Company, Inc., Belleville, New Jersey 07109.

B. *An Accident Prevention Program for School Shops and Laboratories.* U.S. Department of Health, Education, and Welfare, Office of Education.

C. *Safety Practices and Procedures in School Shops.* Department of Education, Division of Vocational Education, State of New Jersey.

SAFETY
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. Safety--The state or condition of being safe; freedom from danger, risk or injury

B. Accident--Includes any suddenly occurring, unintentional event which causes injury or property damage

C. First aid--The immediate, temporary care given the victim of an accident or sudden illness until the services of a physician can be obtained

II. Colors and applications of the safety color code

A. Green--Applied to non-critical parts of equipment and machined surfaces, name plates, and bearing surfaces; designates the location of safety and first aid equipment

B. Yellow--Applied to operating levers, wheels, handles, and hazardous areas which may cause stumbling, falling, or tripping; designates caution

C. Orange--Applied to electrical switches, interior surfaces of doors, on fuse and electrical power boxes, movable guards, and parts; designates dangerous parts of equipment which may cut, crush, shock, or otherwise injure

D. Red--(Physical color associated with fire) Used to identify the location of fire fighting equipment

(NOTE: Emergency fire exits should be designated in red. Buttons or levers for electrical switches used for the stopping of machinery should be designated in red. Gasoline cans should be painted red with additional identification in the form of a yellow band around the can.)

E. Blue--Used as the basic color for designating caution against starting equipment while it is being worked on, or against the use of defective equipment (A blue tag should be lettered "Out of Order.")

F. Ivory--Used to reflect light and "show the way" when applied to label edges, vise jaws, and edges of tool rests

III. Personal safety rules

A. Wear shop clothing appropriate to the instructional activity being performed

B. Confine long hair before operating rotating equipment

INFORMATION SHEET

C. Always wear safety glasses; use suitable helmets and goggles for welding

D. Remove ties when working around machine tools or rotating equipment

E. Remove rings and other jewelry when working in the shop

F. Participate in no horseplay, practical jokes, or running in the shop area

G. Use soap and water frequently as a method of preventing skin diseases

IV. General shop safety rules

A. Keep all hand tools sharp, clean, and in safe working order

B. Report any defective tools, machines, or other equipment to the instructor

C. Keep all guards and safety devices except with the specific authorization of the instructor

D. Operate a hazardous machine only after receiving instruction on how to operate the machine safely

E. Report all accidents to the instructor regardless of nature or severity

F. Turn off the power before leaving a machine tool

G. Make sure all guards and barriers are in place and adjusted properly before starting a machine tool

H. Disconnect the power from machine tools before performing the maintenance task of oiling or cleaning

I. Use a solvent only after determining its properties, what kind of work it has to do, and how to use it

J. Use correct properly fitting wrenches for nuts, bolts, and objects to be turned or held

K. Keep the shop or laboratory floor clear of scraps and litter

L. Clean up any spilled liquids immediately

M. Oily rags or oily waste should be stored in metal containers

N. Clean the chips from a machine with a brush--not with a rag or the bare hands

INFORMATION SHEET

V. Steps in maintaining a clean and orderly shop

A. Machinery and equipment arranged to permit safe efficient work practices and ease in cleaning

B. Materials and supplies safely stacked or stored in proper places

C. Tools and accessories safely stored in cabinets, on racks, or other suitable devices

D. Working areas and work benches clear and free of debris and other hazards

E. Floors clean and free from obstructions and slippery substances

F. Aisles, traffic areas, and exits free of materials and other debris

G. Combustible materials properly disposed of or stored in approved containers

H. Oily rags stored in self-closing or spring-lid metal containers

I. Students working in the area instructed on the proper procedures to follow in keeping the area clean and orderly

J. Sufficient brooms, brushes, and other housekeeping equipment readily available

VI. Types of fires

A. Class A--Fires that occur in ordinary combustible materials such as wood, rags, and rubbish

B. Class B--Fires that occur with flammable liquids such as gasoline, oil, grease, paints, and thinners

C. Class C--Fires that occur in or near electrical equipment such as motors, switchboards, and electrical wiring

D. Class D--Fires that occur in combustible metals such as magnesium, titanium, airconium, or lithium sodium

VII. Types of fire extinguishers (Transparency 1)

A. Pressurized water--Operates usually by squeezing a handle or trigger; used on Class A fires

B. Soda acid--Operates by turning extinguisher upside down; used on Class A fires

(NOTE: Do not use water or soda acid extinguishers on any other type of fire.)

INFORMATION SHEET

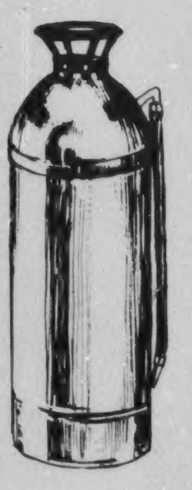
C. Carbon dioxide (CO_2)--Operates usually by squeezing handle or trigger, or lever; used on Class B and C fires

D. Dry chemical--Operates usually by squeezing a handle, trigger, or lever; used on Class B and C fires

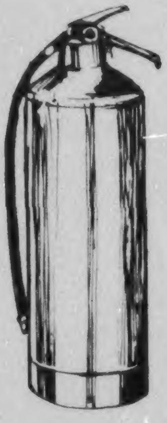
E. Foam--Operates by turning extinguisher upside down; used on Class A and B fires

(NOTE: Special techniques and extinguishing agents are necessary for Class D fires. If you use these materials, consult your fire marshal or fire department.)

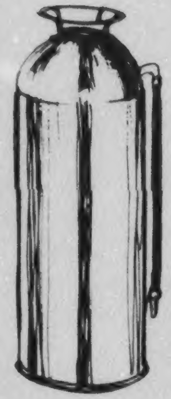
Types of Fire Extinguishers



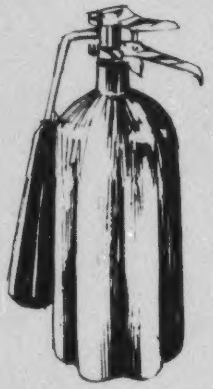
Soda-Acid



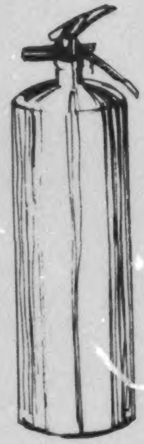
Pressurized Water



Foam



Carbon Dioxide



Dry Chemical

STUDENT SAFETY PLEDGE FORM

______________________________, who is enrolled in Vocational __________

__________, will as a part of his shop experience operate machines, providing that his parent or guardian gives written permission.

It is understood that each student will be given proper instruction, both in the use and in the correct safety procedures or the equipment, before being allowed to operate it himself. The student must assume responsibility for following safe practices, and therefore, we ask that he subscribe to the following safety pledge.

1. I PROMISE TO FOLLOW ALL SAFETY RULES FOR THE SHOP.
2. I PROMISE NEVER TO USE A MACHINE WITHOUT FIRST HAVING PERMISSION FROM THE INSTRUCTOR.
3. I WILL NOT ASK PERMISSION TO USE A PARTICULAR MACHINE UNLESS I HAVE BEEN INSTRUCTED IN ITS USE, AND HAVE MADE 100% ON THE SAFETY TEST FOR THAT MACHINE.
4. I WILL REPORT ANY ACCIDENT OR INJURY TO THE TEACHER IMMEDIATELY.

DATE__________ STUDENT'S SIGNATURE____________________

I hereby give my consent to allow my son to operate all machines and equipment necessary in carrying out the requirements of the course in which he is enrolled.

Date__________ PARENT'S SIGNATURE ____________________

Parents are cordially invited to visit the shop to inspect the machines and see them in operation.

NATIONAL STANDARD SCHOOL SHOP SAFETY INSPECTION CHECK LIST

Prepared by the Joint Safety Committee of the
AMERICAN VOCATIONAL ASSOCIATION — NATIONAL SAFETY COUNCIL

______________________________________ Date________________

____

INTRODUCTION

A safe environment is an essential part of the school shop safety education program. The safe environment will exist only if hazards are discovered and corrected through *regular* and *frequent* inspections by school personnel—administrators, teachers and students. Safety inspections are to determine if everything is satisfactory.

Inspections may be made at the request of the board of education, the school administration or upon the initiative of the teacher. Some communities have drawn upon the cooperative service of professional safety engineers, inspectors of state labor departments, insurance companies and local safety councils to supplement and confirm inspections by school personnel.

The National Standard School Shop Safety Inspection Check List, recommended by the President's Conference on Industrial Safety is an objective inspection procedure for the school shop.

DIRECTIONS

WHO INSPECTS?

This will depend upon local policies. It is recommended, however, that shop teachers, and students—the student safety engineer and/or student safety committee—participate in making regular inspections. This not only tends to share responsibility but stimulates a broader interest in the maintenance of a safe school shop.

WHEN TO INSPECT?

As a minimum, a safety inspection should be made at the beginning of every school term or semester. More frequent inspections may be advisable.

HOW TO INSPECT?

Inspections should be well planned in advance.

Inspections should be systematic and thorough. No location that may contain a hazard should be overlooked.

Inspection reports should be clear and concise, but with sufficient explanation to make each recommendation for improvement understandable.

FOLLOW-UP

The current report should be compared with previous records to determine progress. The report should be studied in terms of the accident situation so that special attention can be given to those conditions and locations which are accident producers.

Each unsafe condition should be corrected as soon as possible in accordance with accepted local procedures.

A definite policy should be established in regard to taking materials and equipment out of service because of unsafe conditions.

The inspection report can be used to advantage as the subject for staff and class discussion.

CHECKING PROCEDURE

Draw a circle around the appropriate letter, using the following letter scheme:

S — Satisfactory (needs no attention)
A — Acceptable (needs some attention)
U — Unsatisfactory (needs immediate attention)

Recommendations should be made in all cases where a "U" is circled. Space is provided at the end of the form for such comments. Designate the items covered by the recommendations, using the code number applicable (as B-2).

In most categories, space is provided for listing of standards, requirements or regulations which have local application only.

A. GENERAL PHYSICAL CONDITION

1. Machines, benches, and other equipment are arranged so as to conform to good safety practices........................ S A U
2. Condition of stairways........................ S A U
3. Condition of aisles........................ S A U
4. Condition of floors........................ S A U
5. Condition of walls, windows, and ceiling........................ S A U
6. Illumination is safe, sufficient, and well placed........................ S A U
7. Ventilation is adequate and proper for conditions........................ S A U
8. Temperature control........................ S A U
9. Fire extinguishers are of proper type, adequately supplied, properly located and maintained........................ S A U
10. Teacher and pupils know location of and how to use proper type for various fires........................ S A U
11. Number and location of exits is adequate and properly identified........................ S A U
12. Proper procedures have been formulated for emptying the room of pupils and taking adequate precautions in case of emergencies S A U
13. Lockers are inspected regularly for cleanliness and fire hazards. S A U
14. Locker doors are kept closed........................ S A U
15. Walls are clear of objects that might fall........................ S A U
16. Utility lines are properly identified........................ S A U
17. Teachers know the procedure in the event of fire including notification of the fire department and the evacuation of the building. S A U
18. Air in shop is free from excessive dust, smoke, etc.... S A U
19. ______________________________ S A U
20. ______________________________ S A U
21. ______________________________ S A U
22. ______________________________ S A U
23. Evaluation for the total rating of A. GENERAL PHYSICAL CONDITION........................ S A U

B. HOUSEKEEPING

1. General appearance as to orderliness S A U

2. Adequate and proper storage space for tools and materials. S A U

3. Benches are kept orderly S A U

4. Corners are clean and clear S A U

5. Special tool racks, in orderly condition, and provided at benches and machines S A U

6. Tool, supply, and/or material room is orderly S A U

7. Sufficient scrap boxes are provided S A U

8. Scrap stock is put in scrap boxes promptly S A U

9. Materials are stored in an orderly and safe condition S A U

10. A spring lid metal container is provided for waste and oily rags. S A U

11. All waste materials and oily rags are promptly placed in the containers S A U

12. Containers for oily rags and waste materials are frequently and regularly emptied S A U

13. Dangerous materials are stored in metal cabinets S A U

14. Machines have been color conditioned S A U

15. Safety cans are provided for flammable liquids S A U

16. Bulk storage of dangerous materials is provided outside of the main building S A U

17. A toe-board or railing around a mezzanine used for storage or washing facilities S A U

18. Materials are stored in an orderly and safe condition on this mezzanine S A U

19. Flammable liquids are not used for cleaning purposes S A U

20. Floors are free of oil, water and foreign material S A U

21. Floors, walls, windows, and ceilings are cleaned periodically. S A U

22. ______________________ S A U

23. ______________________ S A U

24. ______________________ S A U

25. ______________________ S A U

26. Evaluation for the total rating for B. HOUSEKEEPING S A U

C. EQUIPMENT

1. Machines are arranged so that workers are protected from hazards of other machines, passing students, etc. S A U

2. Danger zones are properly indicated and guarded S A U

3. All gears, moving belts, etc., are protected by permanent enclosure guards S A U

4. All guards are used as much as possible S A U

C. EQUIPMENT (continued)

5. All equipment control switches are easily available to operator. S A U

6. All machines are "locked off" when instructor is out of the room. S A U

7. Brushes are used for cleaning equipment S A U

8. Nonskid areas are provided around machines S A U

9. Machines are in safe working condition S A U

10. Machines are guarded to comply with American Standards Association and local state code S A U

11. Adequate supervision is maintained when students are using machines and dangerous tools S A U

12. Tools are kept sharp, clean and in safe working order S A U

13. All hoisting devices are in safe operating condition S A U

14. Machines are shut off while unattended S A U

15. Adequate storage facilities for tools, equipment, etc., not in immediate use S A U

16. ______________________ S A U

17. ______________________ S A U

18. ______________________ S A U

19. ______________________ S A U

20. Evaluation for the total rating for C. EQUIPMENT S A U

D. ELECTRICAL INSTALLATION

1. All switches are enclosed S A U

2. There is a master control switch for all of the electrical installations S A U

3. Electrical outlets and circuits are properly identified S A U

4. All electrical extension cords are in safe condition and are not carrying excessive loads S A U

5. All machine switches are within easy reach of the operators. S A U

6. Electrical motors and equipment are wired to comply with the National Electric Code S A U

7. Individual cut-off switches are provided for each machine. S A U

8. Machines are provided with overload and underload controls by magnetic pushbutton controls S A U

9. No temporary wiring in evidence S A U

10. ______________________ S A U

11. ______________________ S A U

12. ______________________ S A U

13. ______________________ S A U

14. Evaluation for the total rating for D. ELECTRICAL INSTALLATION S A U

E. GAS

1. Gas flow to appliances is regulated, so that when appliance valve is turned on full, the flames are not too high .... S A U

2. Gas appliances are properly insulated with asbestos or other insulating material from tables, benches, adjacent walls, or other flammable materials .... S A U

3. No gas hose is used where pipe connections could be made. S A U

4. Gas appliances have been adjusted so that they may be lighted without undue hazard.................................. S A U

5. Students have been instructed when lighting gas appliances to light the match first before turning on the gas............ S A U

6. There are no gas leaks, nor is any odor of gas detectable in any part of the shop.. S A U

7. Shop instruction has been given concerning the lighting of gas furnaces operating with both air and gas under pressure.. S A U

8. When lighting the gas forge, goggles are worn....... S A U

9. When lighting the gas furnace, the following procedure is used: (a) light the match; (b) turn on the gas; (c) drop the match in the hole in top of the furnace................................ S A U

10. In shutting down the gas furnace, the gas valve is closed before the air valve.. S A U

11. ______________________________ S A U

12. ______________________________ S A U

13. ______________________________ S A U

14. ______________________________ S A U

15. Evaluation for the total rating for E. GAS.......... S A U

F. PERSONAL PROTECTION

1. Goggles or protective shields are provided and required for all work where eye hazards exist...... .... S A U

2. If individual goggles are not provided, hoods and goggles are properly disinfected before use......................... S A U

3. Shields and goggles are provided for electric welding.. S A U

4. Rings and other jewelry are removed by pupils when working in the shop.. S A U

5. Proper kind of wearing apparel is worn and worn properly for the job being done.................................. S A U

6. Leggings, safety shoes, etc., are worn in special classes such as foundry, etc., when needed............................ S A U

7. Respirators are provided for dusty or toxic atmospheric conditions such as when spraying in the finishing room......... S A U

8. Provisions are made for cleaning and sterilizing respirators. S A U

9. Students are examined for safety knowledge ability.. S A U

10. Sleeves are rolled above elbows when operating machines. S A U

11. Clothing of students is free from loose sleeves, flopping ties, loose coats, etc. .... S A U

12. ______________________________ S A U

F. PERSONAL PROTECTION (continued)

13. ______________________________ S A U

14. ______________________________ S A U

15. ______________________________ S A U

16. Evaluation for the total rating for F. PERSONAL PROTECTION. S A U

G. INSTRUCTION

1. Shop Safety is taught as an integral part of each teaching unit. S A U

2. Safety rules are posted particularly at each danger station. S A U

3. Printed safety rules are given each student.......... S A U

4. Pupils take a safety pledge........................ S A U

5. Use of a safety inspector........................ S A U

6. Use of a student shop safety committee.............. S A U

7. Use of safety contests............................ S A U

8. Motion and/or slide films on safety are used in the instruction. S A U

9. Use of suggestion box............................ S A U

10. Use of safety tests.............................. S A U

11. Use of safety posters............................ S A U

12. Talks on safety are given to the classes by industrial men. S A U

13. Tours are taken of industrial plants as a means of studying safety practices .... S A U

14. Periodic safety inspections of the shop are made by a student committee .... S A U

15. Men from industry make safety inspections of the shop S A U

16. Student shop safety committee investigates all accidents S A U

17. A proper record is kept of safety instructions which are given, preferably showing the signature of student on tests given in this area .... S A U

18. Rotate students on the Shop Safety Committee so that as many students as possible have an opportunity to participate... S A U

19. ______________________________ S A U

20. ______________________________ S A U

21. ______________________________ S A U

22. ______________________________ S A U

23. Evaluation for the total rating of G. INSTRUCTION S A U

H. ACCIDENT RECORDS

1. There is a written statement outlining the proper procedure when and if a student is seriously hurt........................ S A U

2. Adequate accident statistics are kept................. S A U

3. Accidents are reported to the proper administrative authority by the instructor .... S A U

H. ACCIDENT RECORD (continued)

4. A copy of each accident report is filed with the State Department of Education .... S A U

5. Accident reports are analyzed for instructional purposes and to furnish the basis for elimination of hazards.............. S A U

6. ______________________________ S A U

7. ______________________________ S A U

8. ______________________________ S A U

9. ______________________________ S A U

10. Evaluation for the total rating of H. ACCIDENT RECORDS. S A U

I. FIRST AID

1. An adequately stocked first aid cabinet is provided... S A U

2. The first aid is administered by a qualified individual S A U

3. The school has individuals qualified to administer first aid. S A U

4. ______________________________ S A U

5. ______________________________ S A U

6. ______________________________ S A U

7. ______________________________ S A U

8. Evaluation for the total rating of I. FIRST AID.... S A U

RECOMMENDATIONS

Code No.	

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SAFETY
UNIT I

TEST

1. Match each of these definitions with the correct term on the right.

_____a. The state or condition of being safe; freedom from danger, risk, or injury

_____b. Includes any suddenly occuring, unintentional event which causes injury or property damage

_____c. The immediate, temporary care given the victim of an accident or sudden illness until the services of a physician can be obtained

1. Accident
2. First aid
3. Safety

2. Match the following colors of the safety color code with the correct statements of their use.

_____a. Designates caution

_____b. Used to identify the location of fire fighting equipment

_____c. Designates the location of safety and first aid equipment

_____d. Designates dangerous parts of equipment which may cut, crush, shock, or otherwise injure

_____e. Designates caution against starting equipment while it is being worked on, or against the use of defective equipment

_____f. Used to reflect light and "show the way"

1. Green
2. Ivory
3. Orange
4. Purple
5. Blue
6. Red
7. Yellow

3. Place an "X" before the personal safety rules.

______a. Wear cut-off jeans while welding

______b. Remove rings and other jewelry when working in the shop

______c. Wear safety glasses only when welding

______d. Horseplay is safe in shop areas away from the rotating equipment

______e. Use soap and water frequently as a method of preventing skin diseases

______f. Remove ties when working around machine tools or rotating equipment

______g. Always wear safety glasses; use suitable helment and goggles for welding

______h. A medallion on a chain around the neck is safe, since the chain will probably break if it gets caught in a machine

______i. Confine long hair before operating rotating equipment

4. Place an "X" before the general shop safety rules.

______a. Use an electric drill with a missing ground wire

______b. Turn off a defective machine and tell no one that it is defective

______c. Keep all guards and safety devices except with the specific authorization of the instructor

______d. Operate a hazardous machine by trial and error if the instructor has not had time to give instruction on how to operate the machine safely

______e. Keep all hand tools sharp, clean, and in safe working order

______f. Turn off the power before leaving a machine tool

______g. Report only severe accidents to the instructor

______h. Wait until the end of the class period to clean up all spills

______i. Clean the chips from a machine with a brush

______j. Oil the power tools while they are running so that the oil will get to the working parts

______k. Oily rags should be stored in metal containers

______l. Keep the shop floor clear of scraps and litter

______m. Use a power tool with a guard missing, but be extremely careful since the instructor did not authorize removing the guard _____n. Use correct properly fitting wrenches for nuts, bolts, and objects to be turned or held

_____o. Use a solvent only after determining its properties, what kind of work it has to do, and how to use it

5. Place an "X" before those steps that are necessary to maintain a clean and orderly shop.

_____a. Sufficient brooms, brushes, and other housekeeping equipment readily available

_____b. Oily rags tossed in an unused corner of the shop

_____c. Scrap metal stacked across one of the exits

_____d. Floors clean and free from obstructions and slippery substances

_____e. Students working without being instructed on the proper procedures to follow in keeping the area clean

_____f. Working areas and work benches clean and free of debris and other hazards

_____g. Machines arranged so that it is difficult to clean around them

_____h. Materials and supplies left wherever they were last used

_____i. Tools and accessories safely stored in cabinets, on racks, or other suitable devices

_____j. Open pans of gasoline sitting around the shop

6. Match the classes of fire with the correct statements defining each class.

_____a. Fires that occur with flammable liquids such as gasoline, oil, or grease

_____b. Fires that occur in ordinary combustible materials such as wood, rags, and rubbish

_____c. Fires that occur in or near electrical equipment such as motors, switchboards, and electrical wiring

_____d. Fires that occur in combustible metals such as magnesium, airconium, or lithium sodium

1. Class A
2. Class B
3. Class C
4. Class D

7. Write the number or numbers of the fire extinguishers best suited to extinguish each class of fire.

_____ a. Fires that occur with flammable liquids such as gasoline, oil, grease

_____ b. Fires that occur in or near electrical equipment such as motors, switchboards, and electrical wiring

_____ c. Fires that occur in ordinary combustible materials such as wood, rags, and rubbish

1. Pressurized water
2. Carbon Dioxide (CO_2)
3. Pump tank
4. Dry chemical
5. Soda acid
6. Foam

SAFETY
UNIT I

ANSWERS TO TEST

1. a. 3
   b. 1
   c. 2
2. a. 7
   b. 6
   c. 1
   d. 3
   e. 5
   f. 2
3. b
   e
   f
   g
   i
4. c
   e
   f
   i
   k
   l
   n
   o
5. a
   d
   f
   i
6. a. 2
   b. 1
   c. 3
   d. 4
7. a. 2, 4, 6
   b. 2, 4
   c. 1, 5, 6

HAND TOOLS
UNIT II

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to select basic rules for the care and safe use of hand tools, identify various types of hand tools, and demonstrate the ability to use tools safely. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Select from a list four basic rules concerning the care of hand tools.
2. Select from a list five basic rules concerning the safe use of hand tools.
3. Identify nine types of wrenches.
4. Identify six types of pliers.
5. Identify three types of vises.
6. Select the picture of a hacksaw.
7. Identify four types of files.
8. Identify three types of punches.
9. Match the names of four types of chisels with the pictures of the chisels.
10. Identify four types of screwdrivers.
11. Identify three types of drills.
12. Identify two types of metal cutting tools.
13. Match the names of seven types of hammers with the pictures of the hammers.
14. Match the names of seven types of measuring tools with the pictures of the tools.
15. Match the names of five small engine repair tools with the correct picture of each.
16. Demonstrate the ability to use tools safely.

HAND TOOLS
UNIT II

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide each student with objective sheet.

   B. Provide each student with information sheet.

   C. Make transparencies.

   D. Discuss terminal and specific objectives.

   E. Discuss information sheet.

   F. Give test.

II. Students:

   A. Read objectives.

   B. Study information sheet.

   C. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM 1--Types of Wrenches

      2. TM 2--Types of Pliers

      3. TM 3--Types of Vises and Hacksaws

      4. TM 4--Types of Files and Punches

      5. TM 5--Types of Chisels and Screwdrivers

      6. TM 6--Types of Drills and Metal Cutting Tools

7. TM 7--Types of Hammers
8. TM 8--Types of Measuring Tools
9. TM 9--Small Engine Repair Tools

D. Test

E. Answers to test

II. References:

A. Phipps, Lloyd J. *Mechanics in Agriculture.* Danville, Illinois: Interstate Publishers, 1967.

B. *ABC's of Hand Tools.* Detroit, Michigan: General Motors Corporation, 1945.

C. Krar, S. F., J. W. Oswald, and J. E. St. Amand. *Technology of Machine Tools.* Toronto, Canada: McGraw-Hill Company of Canada Limited, 1969.

D. Dragoo, A. W. and Howard O. Reed. *General Shop Metalwork.* Bloomington, Illinois: McKnight and McKnight Publishing Company, 1964.

E. *Bench Work, Machine Shop Series.* Albany, New York: Delmar Publishers, Inc., 1964.

F. *Briggs and Stratton Repair Instructions III.* Milwaukee, Wisconsin: Briggs and Stratton Corporation.

HAND TOOLS
UNIT II

INFORMATION SHEET

I. Basic rules concerning the care of hand tools

   A. Keep tools sharp

   B. Protect the cutting edge of tools when carrying or storing

   C. Keep tools dry and lightly oiled when not in use

   D. Use tools only for the purpose for which they were intended

II. Basic rules concerning the safe use of hand tools

   A. Use the right tool for the job

   B. Do not use dull or broken tools

   C. Be sure that tool handles are in good condition and securely fastened to the body of the tool

   D. Do not throw tools

   E. Keep fingers away from edges of cutting tools and work away from the body

III. Wrenches (Transparency 1)

   A. Fixed jaw

      1. Open end

      2. Box end

      3. Combination

      4. Socket

      5. Allen (Setscrew)

   B. Adjustable jaw

      1. Open-end adjustable

      2. Monkey

      3. Vise grip

      4. Pipe

INFORMATION SHEET

IV. Pliers (Transparency 2)

- A. Channel lock
- B. Needle nose
- C. Combination slip-joint
- D. Vise grip
- E. Diagonal
- F. Lineman (Electrician's)

V. Vises (Transparency 3)

- A. Machinist's
- B. Blacksmith's
- C. General utility

VI. Hacksaws (Transparency 3)

(NOTE. Use a coarse tooth blade for sawing heavy work; use a fine tooth blade for light and hollow materials.)

VII. Files (Transparency 4)

- A. Flat
- B. Half round
- C. Round
- D. Taper triangle

VIII. Punches (Transparency 4)

- A. Center
- B. Solid
- C. Pin

IX. Cold chisels (Transparency 5)

- A. Flat
- B. Cape
- C. Round nose
- D. Diamond point

INFORMATION SHEET

X. Screwdrivers (Transparency 5)
   A. Standard
   B. Phillips
   C. Spiral ratchet
   D. Offset
XI. Drills (Transparency 6)
   A. Hand
   B. Breast
   C. Carpenter's brace
XII. Metal cutting tools (Transparency 6)
   A. Hand snips
   B. Bolt cutters
XIII. Hammers (Transparency 7)
   A. Ball-peen (Machinist's)
   B. Sledge
   C. Machinist's riveting
   D. Blacksmith's
   E. Soft-face
   F. Claw
   G. Engineer's
XIV. Measuring tools (Transparency 8)
   A. Feeler gage
   B. Calipers
      1. Outside
      2. Inside

INFORMATION SHEET

- C. Steel tape
- D. Micrometer
- E. Steel rule
- F. Combination square

XV. Small engine repair tools (Transparency 9)

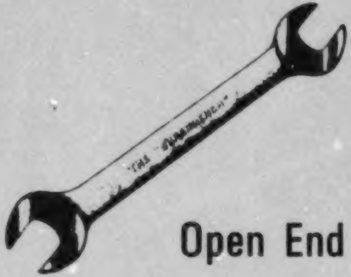
- A. Ring compressor
- B. Starter wrench
- C. Flywheel holder
- D. Flywheel puller
- E. Spring compressor

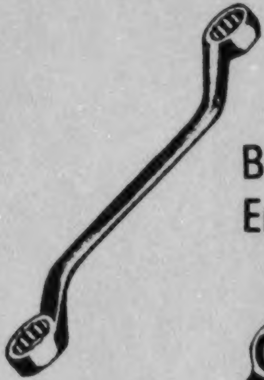
XVI. Safety in the use of hand tools

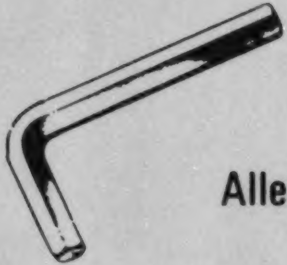
- A. Keep all handles tight
- B. A screwdriver should not be used as a pry or chisel
- C. Select the correct sized screwdriver
- D. Always pull so that the strain is against the solid jaw of an adjustable wrench
- E. Pushing on a wrench is dangerous
- F. Mushroomed heads on chisels should be ground off
- G. Use a handle on a file
- H. A file is not for prying or hammering
- I. Use the proper tool for the job
- J. Store tools in the proper place
- K. Clean tools frequently

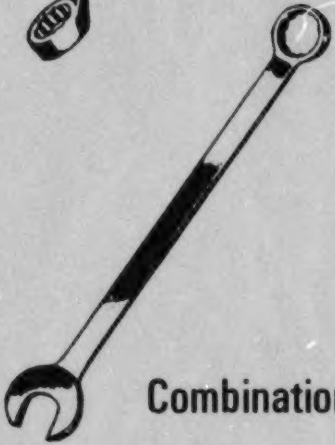
Types of Wrenches

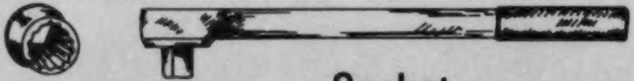
FIXED JAW


Open End

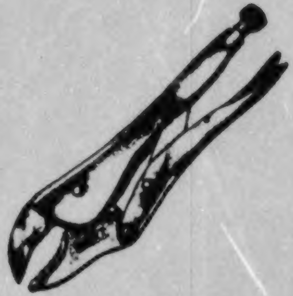

Box End

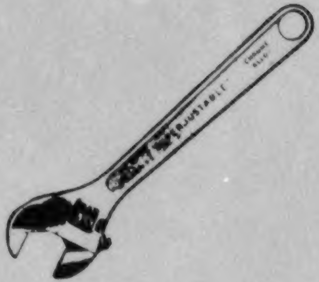

Allen

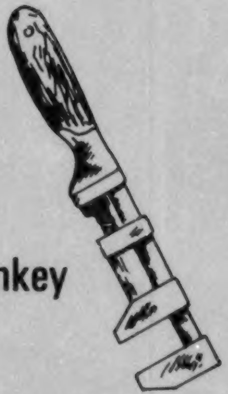

Combination

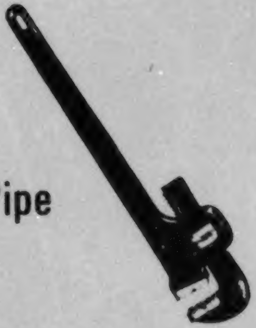

Socket

ADJUSTABLE JAW

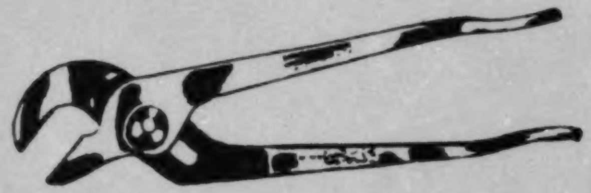

Vise Grip


Adjustable

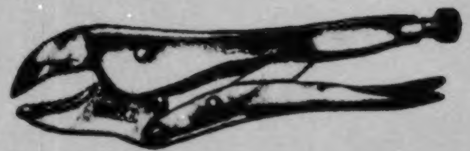

Monkey


Pipe

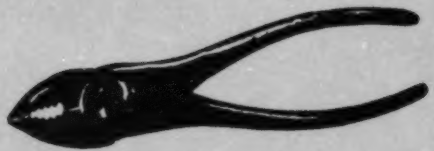
Types of Pliers



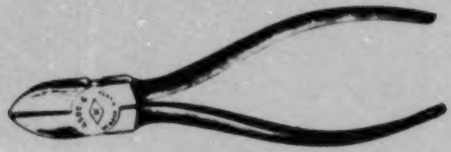
Channel Lock



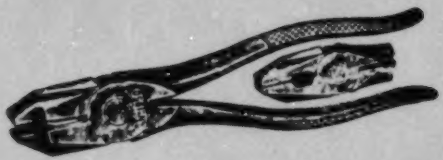
Vise Grip



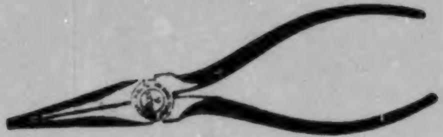
Combination Slip Joint



Diagonal



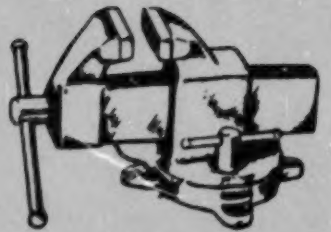
Linemen's



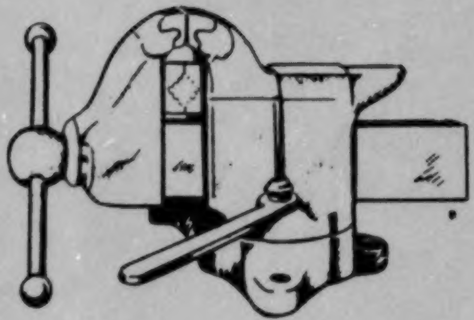
Needle Nose

Types of Vises and Hacksaws

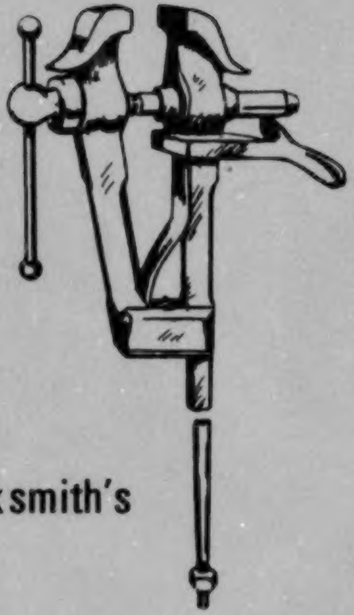
VISES



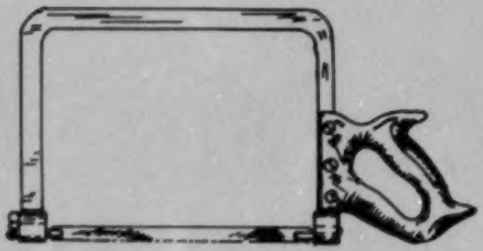
Machinist's

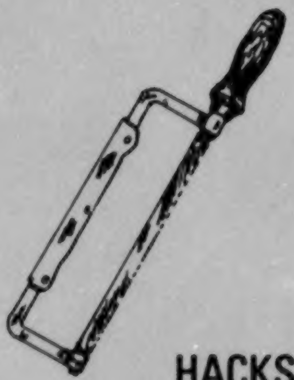


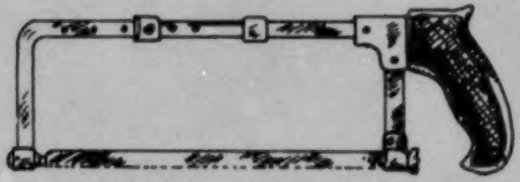
General Utility



Blacksmith's



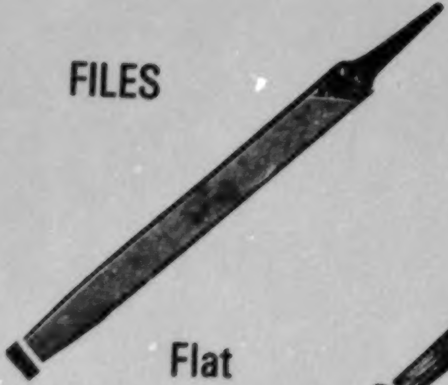




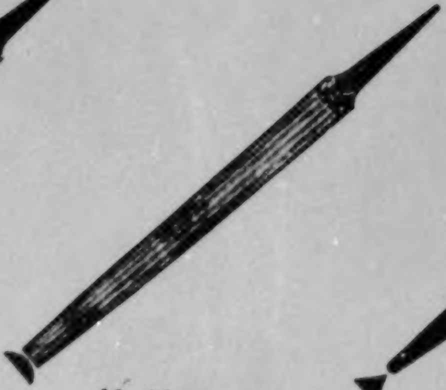
HACKSAWS

Types of Files and Punches

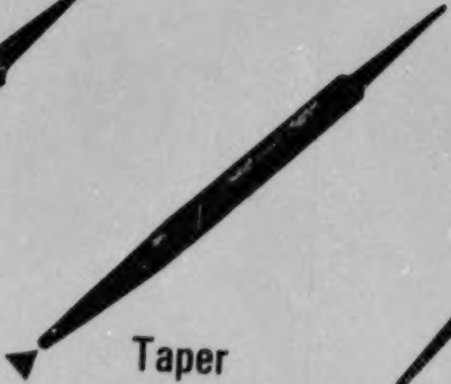
FILES



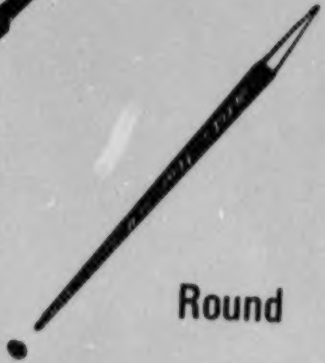
Flat



Half-Round

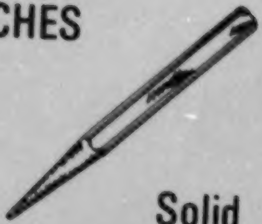


Taper Triangular

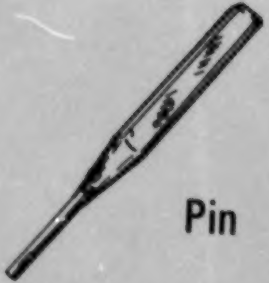


Round

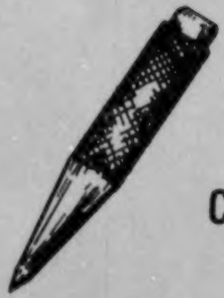
PUNCHES



Solid

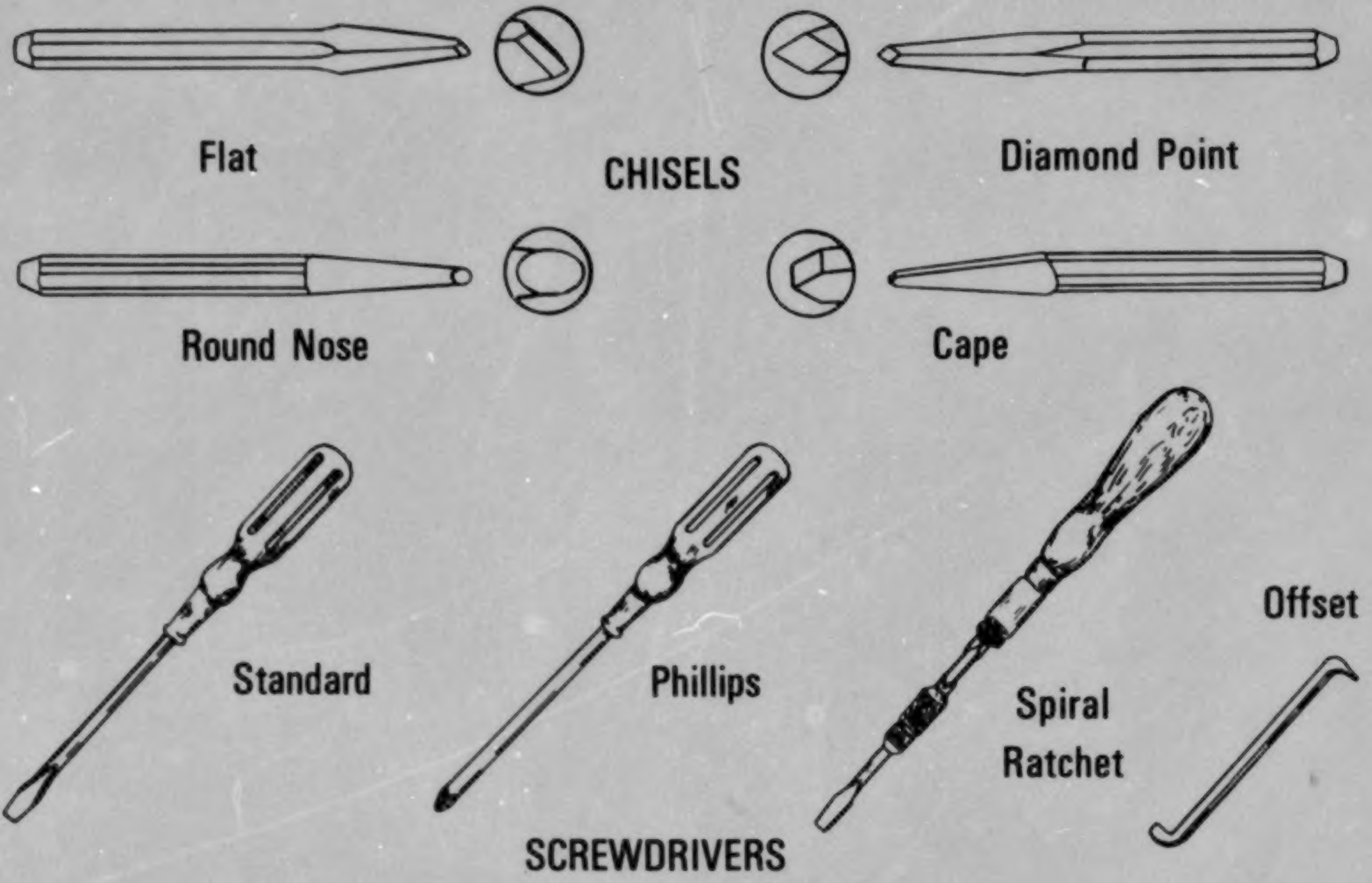


Pin

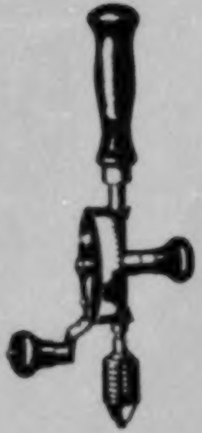


Center

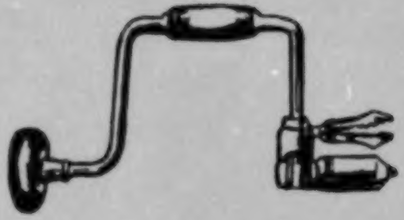
Types of Chisels and Screwdrivesrs


Flat
CHISELS
Diamond Point
Round Nose
Cape
Standard
Phillips
Spiral
Ratchet
Offset
SCREWDRIVERS

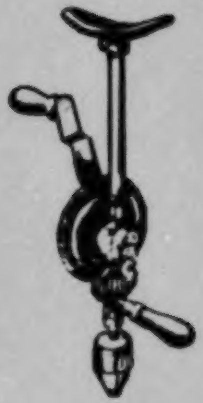
Types of Drills and Metal Cutting Tools



Hand

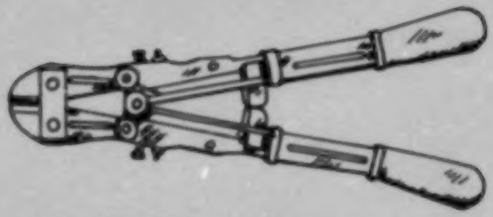


Carpenter's Brace

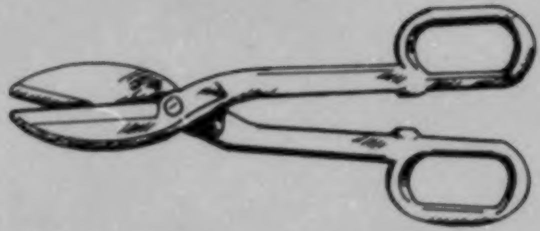


Breast

DRILLS



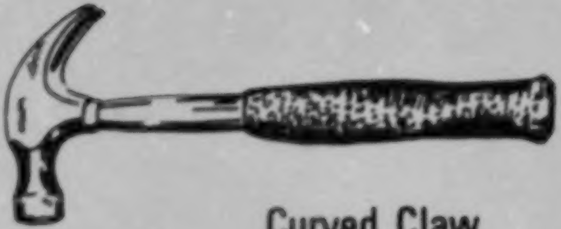
Bolt Cutters



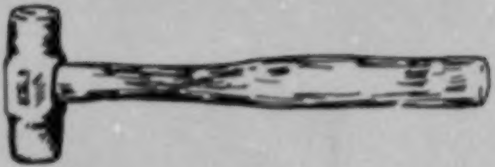
Tin Snips

CUTTING TOOLS

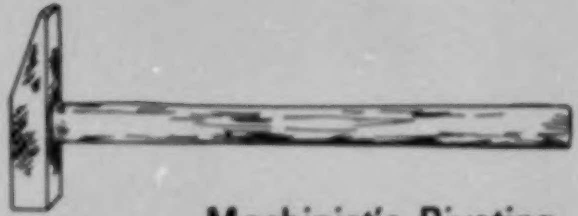
Types of Hammers



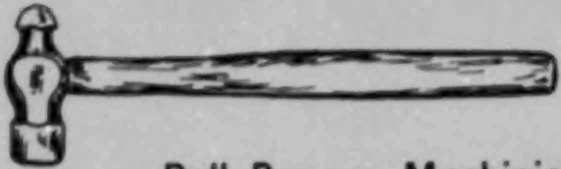
Curved Claw



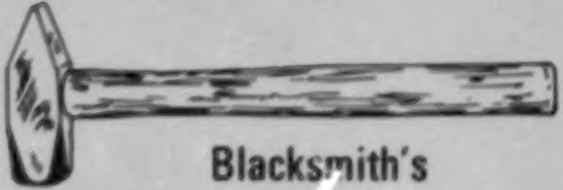
Engineer's



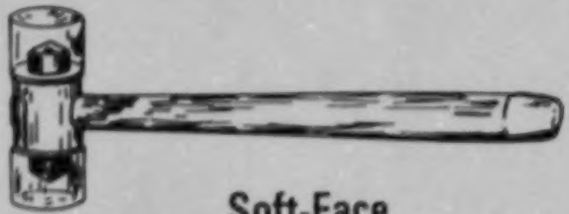
Machinist's Riveting



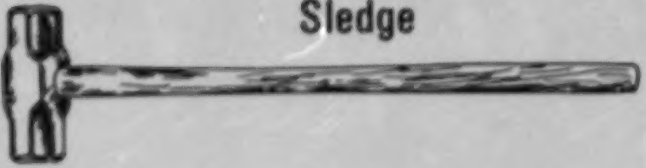
Ball-Peen or Machinist's



Blacksmith's

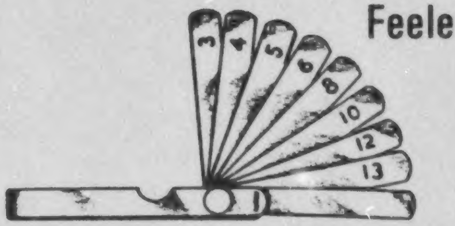


Soft-Face

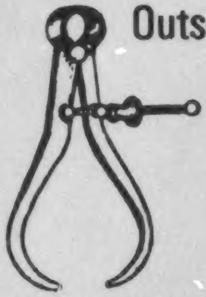


Sledge

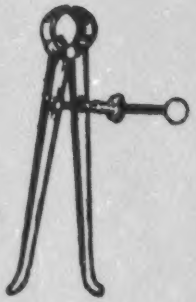
Types of Measuring Tools


3
4
5
6
8
10
12
13

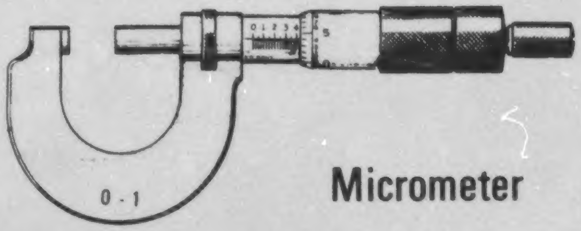
Feeler Gage



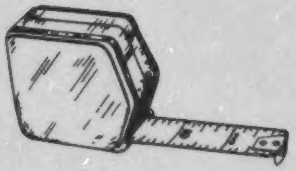
Outside Caliper



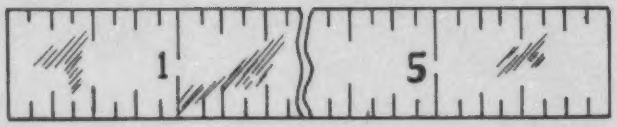
Inside Caliper



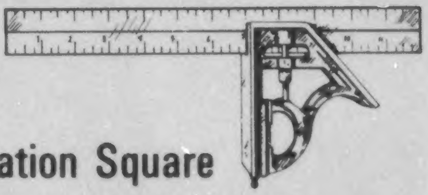
Micrometer



Steel Tape

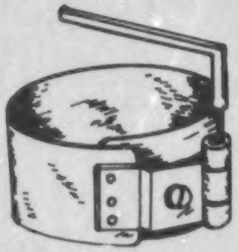


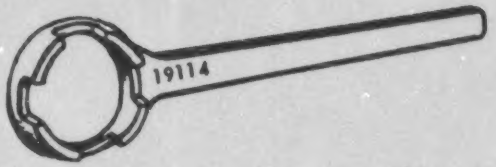
Steel Rule

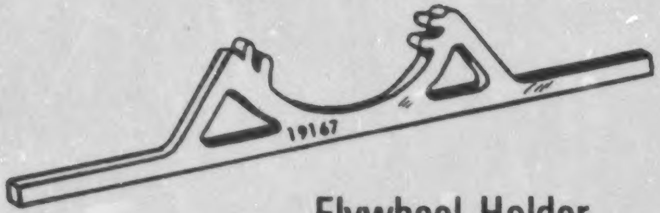


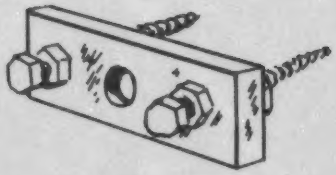
Combination Square

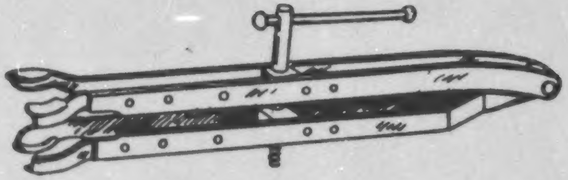
Small Engine Repair Tools


Ring Compressor


19114
Starter Wrench


19167
Flywheel Holder


Flywheel Puller


Spring Compressor

HAND TOOLS
UNIT II

TEST

1. Select and place an "X" before the rules concerning the care of hand tools.

______a. Keep tools sharp

______b. A screwdriver makes a good pry bar

______c. Keep tools dry and lightly oiled when not in use

______d. Protect the cutting edge of tools when carrying or storing

______e. Use tools only for the purpose for which they were intended

2. Select and place an "X" before the rules concerning the safe use of hand tools.

______a. Do not throw tools

______b. Hammer harder on a dull chisel to make it work

______c. Tap the loose handle back in a hammer every once in a while and continue using it

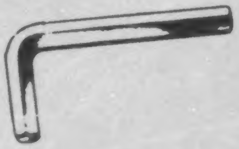
______d. Keep fingers away from edges of cutting tools and work away from the body

______e. Do not use dull or broken tools

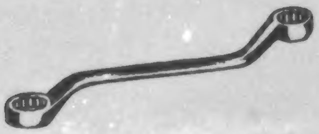
______f. Be sure that tool handles are in good condition and securely fastened to the body of the tool

3. Identify these wrenches

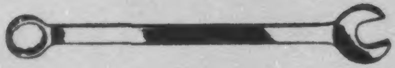
a.________________



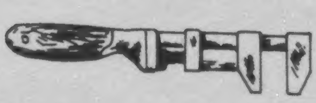
b.________________



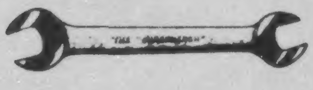
c. ____________________



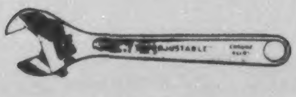
d. ____________________



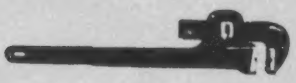
e. ____________________



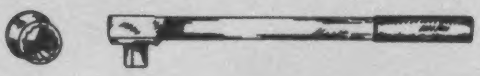
f. ____________________


ADJUSTABLE

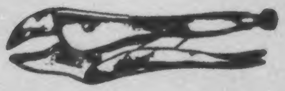
g. ____________________



h. ____________________

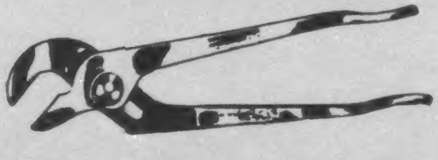


i. ____________________

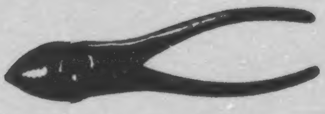


4. Identify these types of pliers.

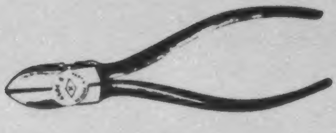
a. ____________________



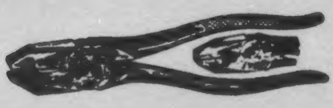
b. ____________________



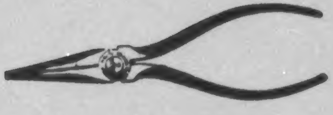
c.____________________



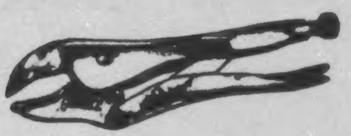
d.____________________



e.____________________

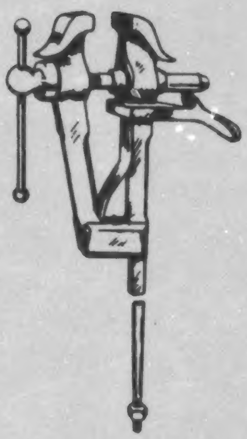


f.____________________

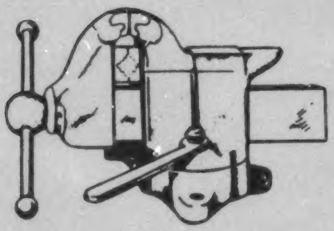


5. Identify these types of vises.

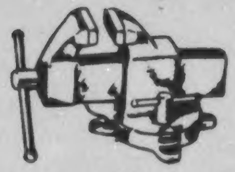
a.____________________



b.__________________

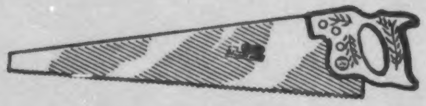


c.__________________

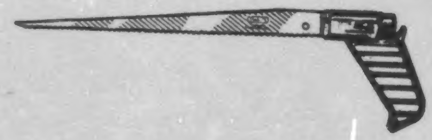


6. Select and circle the picture of the hacksaw.

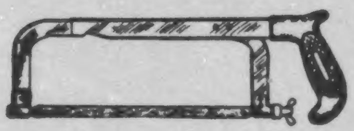
a.



b.

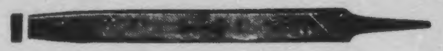


c.

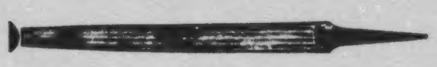


7. Identify these types of files.

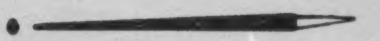
a.________________



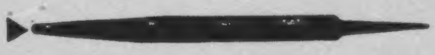
b.________________



c.________________

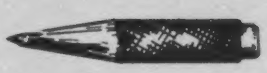


d.________________

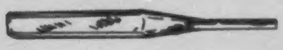


8. Identify these types of punches.

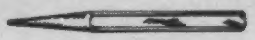
a.________________



b.________________

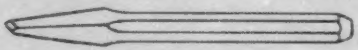


c.________________

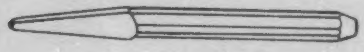


9. Match the names of the chisels with the correct picture.

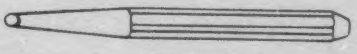
_____a.



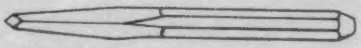
_____b.



_____c.



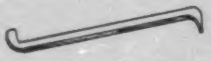
_____d.



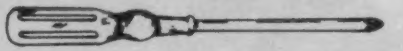
1. Cape
2. Diamond point
3. Flat
4. Round nose

10. Identify these types of screwdrivers.

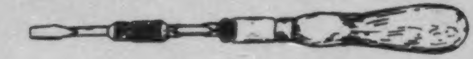
a.________________



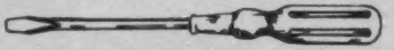
b.____________________



c.____________________

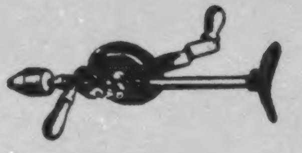


d.____________________

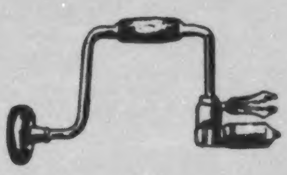


11. Identify these types of drills.

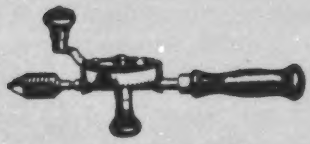
a.____________________



b.____________________

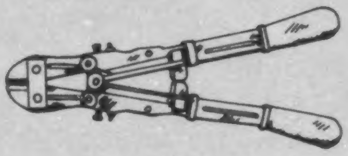


c.____________________

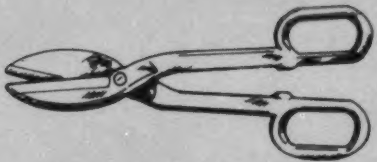


12. Identify these metal cutting tools.

a.____________________



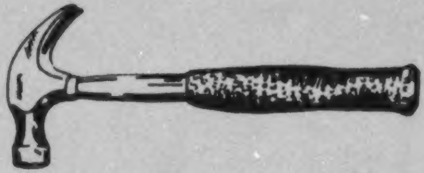
b.____________________



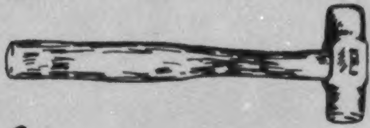
13. Match the names of the hammers with the correct picture.

1. Ball-peen (Machinist's)
2. Blacksmith's
3. Curved claw
4. Engineer's
5. Machinist's riveting
6. Sledge
7. Soft-face

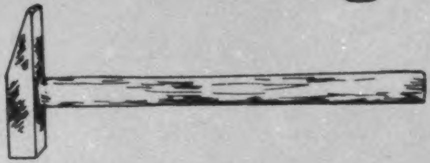
______a.



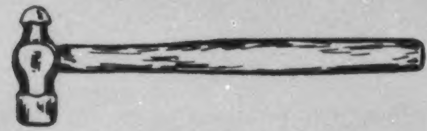
______b.



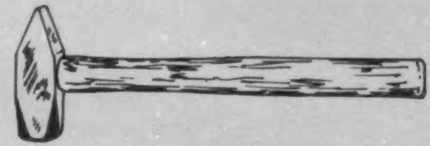
______c.



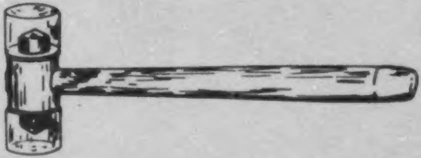
______d.



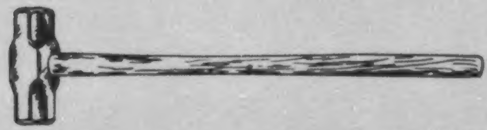
______e.



______f.



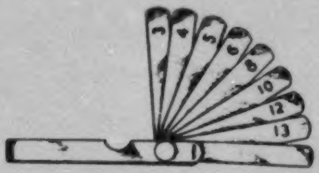
______g.



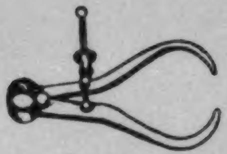
14. Match the names of the measuring tools with the correct picture.

1. Combination square
2. Feeler gage
3. Inside caliper
4. Micrometer
5. Outside caliper
6. Steel rule
7. Steel tape

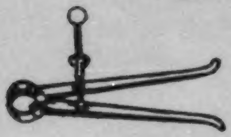
______a.



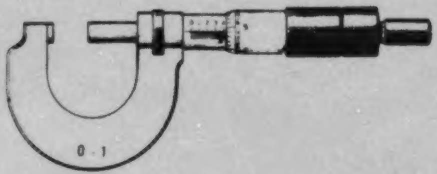
______b.



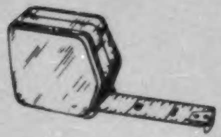
______c.



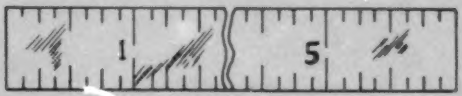
______d.



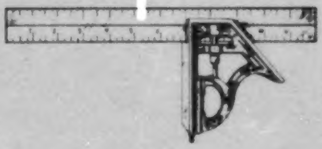
______e.



______f.



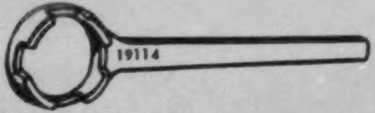
______g.



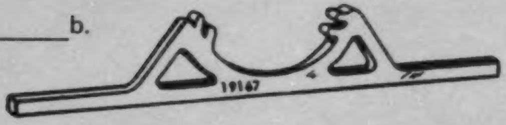
15. Match these names with the correct picture of the tool.

1. Flywheel holder
2. Flywheel puller
3. Ring compressor
4. Spring compressor
5. Starter wrench

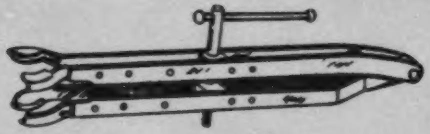
_____a.



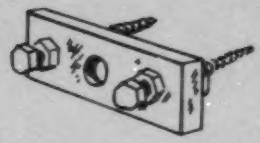
_____b.



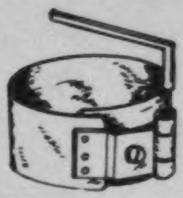
_____c.



_____d.



_____e.



16. Demonstrate the ability to use tools safely.

(NOTE: This is an activity you will be doing all year.)

HAND TOOLS
UNIT II

ANSWERS TO TEST

1. a
   c
   d
   e
2. a
   d
   e
   f
3. a. Allen or setscrew
   b. Box end
   c. Combination
   d. Monkey
   e. Open end
   f. Open end adjustable
   g. Pipe
   h. Socket
   i. Vise grip
4. a. Channel lock
   b. Combination slip-joint
   c. Diagonal
   d. Linemen's
   e. Needlenose
   f. Vise grip

5. a. Blacksmith's
   b. General utility
   c. Machinist's

6. c

7. a. Flat
   b. Half-round
   c. Round
   d. Taper triangular

8. a. Center
   b. Pin
   c. Solid

9. a. 3
   b. 1
   c. 4
   d. 2

10. a. Offset
    b. Phillips
    c. Spiral ratchet
    d. Standard

11. a. Breast
    b. Carpenter's brace
    c. Hand

12. a. Bolt cutters
    b. Tin snips

13. a. 3
    b. 4
    c. 5

d. 1

e. 2

f. 7

g. 6

14. a. 2

b. 5

c. 3

d. 4

e. 7

f. 6

g. 1

15. a. 5

b. 1

c. 4

d. 2

e. 3

16. Performance skills will be evaluated to the satisfaction of the instructor.

BASIC MEASUREMENT
UNIT I

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to identify tools used in measuring, match basic units of measurement with the correct rule, classify 1/8 inch, 1/16 inch, and 1/32 inch scale rules, and demonstrate the ability to read a rule to the 1/16 inch scale. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Identify five tools used in basic measuring.
2. Match three basic units of measurement found on rules with the correct rule.
3. Classify rules as either 1/8 inch, 1/16 inch, or 1/32 inch scale.
4. Demonstrate the ability to:
   a. Read a rule when given a drawing of the rule and locations on the rule.
   b. Measure objects to a given scale.
   c. Construct lines to given lengths.

BASIC MEASUREMENT
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information and assignment sheets.

   C. Make transparencies.

   D. Discuss terminal and specific objectives.

   E. Discuss information and assignment sheets.

   F. Collect different types of measuring tools and demonstrate each to the students.

   G. Give test.

II. Student:

   A. Read objectives.

   B. Study information sheet.

   C. Complete assignment sheets.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM 1--Types of Measuring Tools

      2. TM 2--Units of Measurement

      3. TM 3--The Eighths Rule

      4. TM 4--The Sixteenths Rule

      5. TM 5--The Thirty-Seconds Rule

D. Assignment sheets
  1. Assignment Sheet #1--Read a Rule
  2. Assignment Sheet #2a--Line Measurement
  3. Assignment Sheet #2b--Object Measurement
  4. Assignment Sheet #3--Line Construction

E. Answers to assignment sheets

F. Test

G. Answers to test

II. References:

A. Bureau of Naval Personnel. *Tools and Their Uses.* Washington, D.C.: U.S. Government Printing Office, 1971.

B. Bernstein, Allen L. and David W. Wells. *Trouble-Shooting Mathematics Skills.* New York: Holt, Rinehart, and Winston, Inc., 1969.

C. Curriculum and Instructional Materials Center. *Machine Shop.* Stillwater, Oklahoma: Oklahoma State Board of Vocational and Technical Education, 1972.

BASIC MEASUREMENT
UNIT I

INFORMATION SHEET

I. Types of measuring tools (Transparency 1)

A. Steel rule

B. Steel tape

C. Yard stick

D. Zig-zag rule

E. Combination square

II. Basic units of measurement (Transparency 2)

A. Fractional

B. Decimal

C. Metric

III. Fractional units found on rules (Transparencies 3, 4, and 5)

A. Eighths scale (1/8")

B. Sixteenths scale (1/16")

C. Thirty-seconds scale (1/32")

IV. Reading the rule

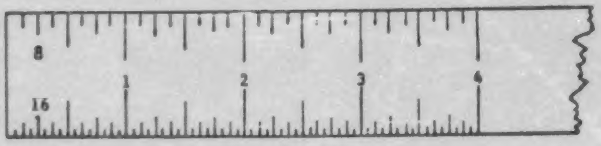
A. Determine the scale

B. Count the number of divisions from the last whole inch to the measurement

C. Count the whole inches (when included)

D. Reduce to lowest terms

Example:



1. The scale is 16ths

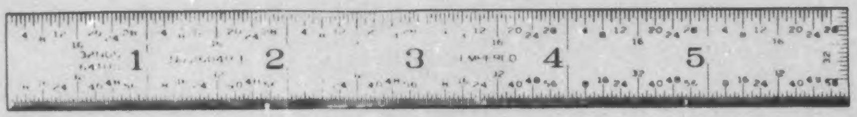
2. There are 10 divisions after the three inch mark

INFORMATION SHEET

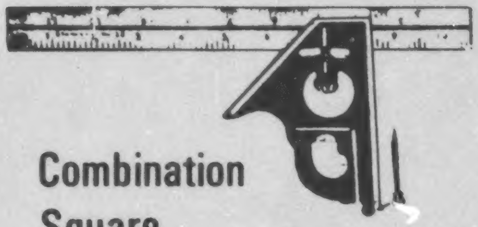
3. There are three whole inches included in the measure

4. 3 10/16 = 3 5/8

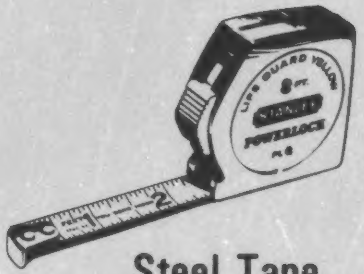
Types of Measuring Tools



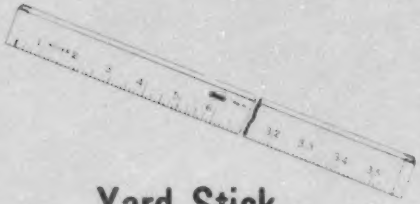
Steel Rule



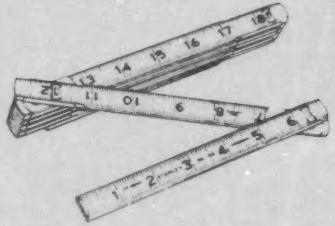
Combination Square


LIFE GUARD YELLOW
8 FT.
STANLEY
POWERLOCK
PL 8
2

Steel Tape

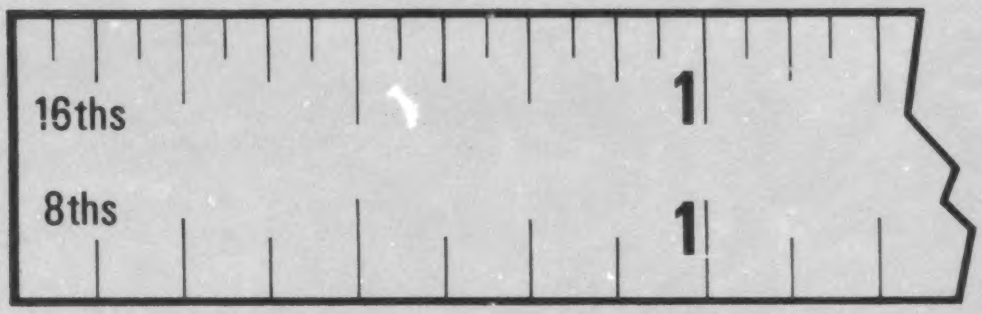


Yard Stick

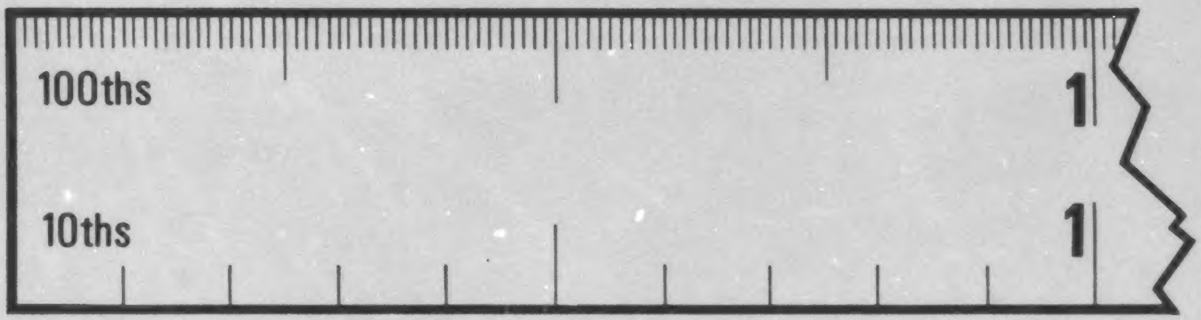


Zig-Zag Ruler

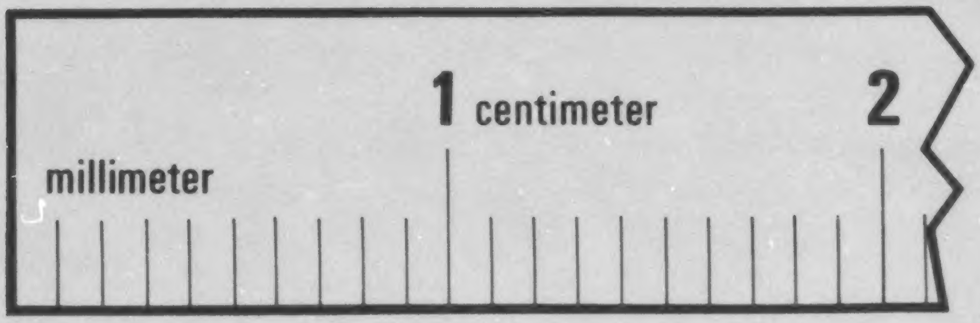
Units of Measurement


16ths
1
8ths
1

Fractional Rule

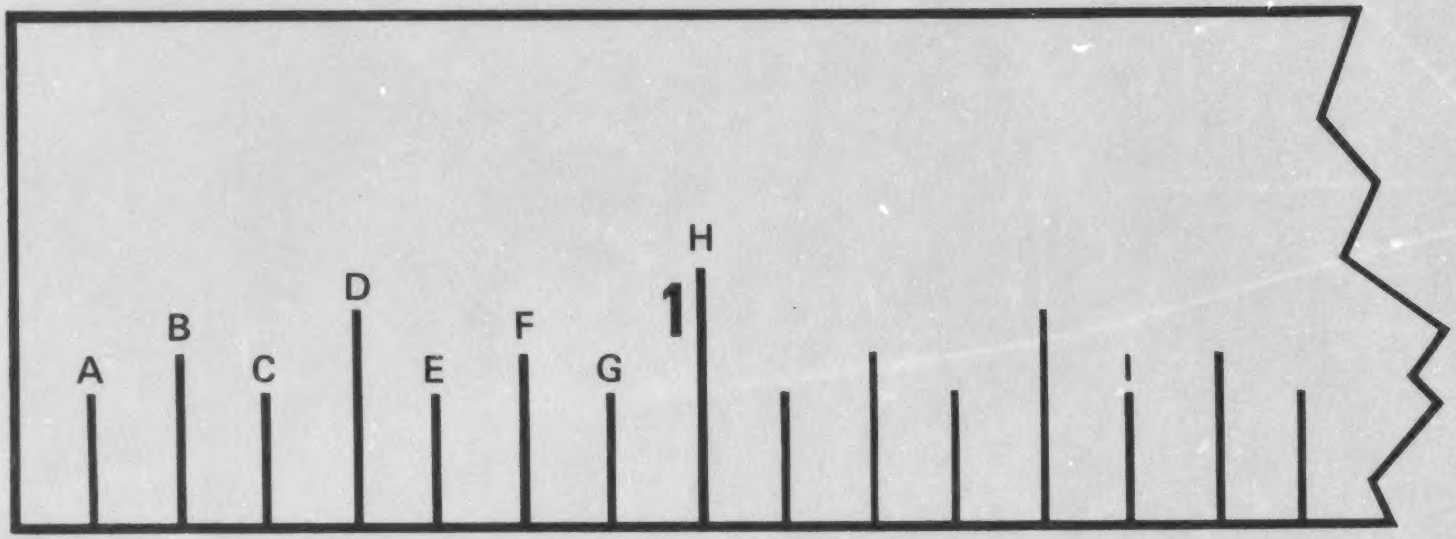

100ths
1
10ths
1

Decimal Rule


1 centimeter
2
millimeter

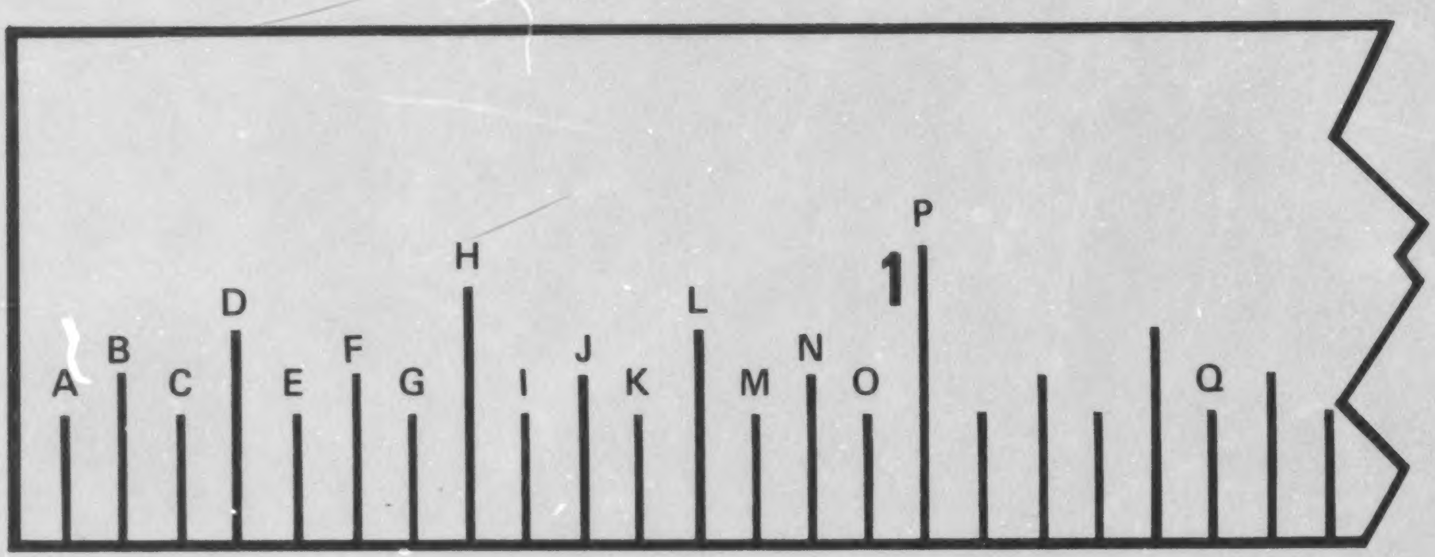
Metric Rule

The Eighths Rule


A
B
C
D
E
F
G
1
H
I

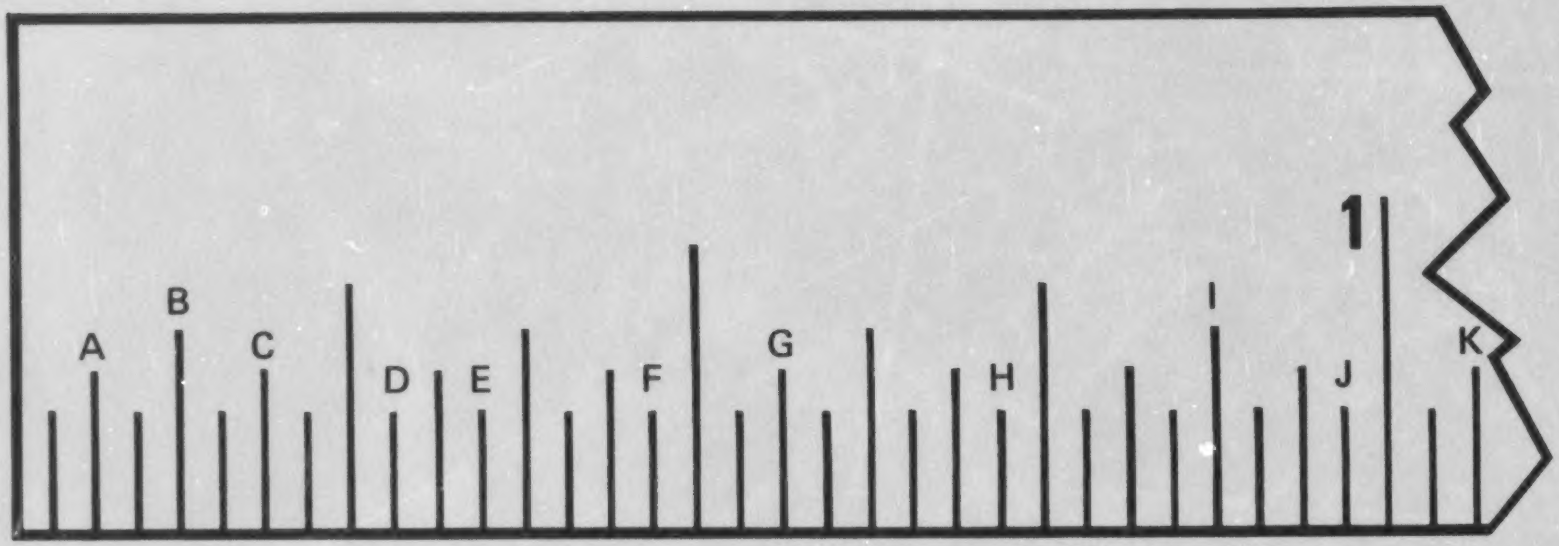
A = 1/8, B = 2/8 = 1/4, C = 3/8, D = 4/8 = 1/2,
E = 5/8, F = 6/8 = 3/4, G = 7/8, H = 8/8 = 1,
I = 13/8 = 1 5/8

The Sixteenths Rule


A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
1
P
Q

A = 1/16, B = 2/16 = 1/8, C = 3/16, D = 4/16 = 1/4,
E = 5/16, F = 6/16 = 3/8, G = 7/16, H = 8/16 = 1/2,
I = 9/16, J = 10/16 = 5/8, K = 11/16, L = 12/16 = 3/4,
M = 13/16, N = 14/16 = 7/8, O = 15/16, P = 16/16 = 1,
Q = 22/16 = 1 6/16 = 1 3/8

The Thirty-Seconds Rule

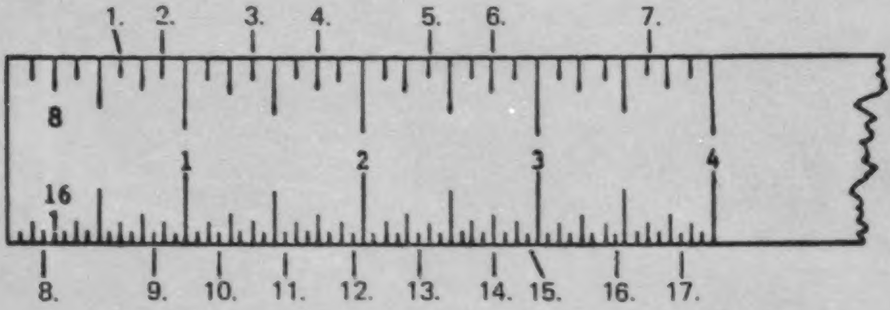

A
B
C
D
E
F
G
H
I
J
K
1

A = 2/32 = 1/16, B = 4/32 = 1/8, C = 5/32, D = 9/32,
E = 11/32, F = 15/32, G = 18/32 = 9/16, H = 23/32,
I = 28/32 = 14/16 = 7/8, J = 31/32,
K = 34/32 = 1 2/32 = 1 1/16

BASIC MEASUREMENT
UNIT I

ASSIGNMENT SHEET #1--READ A RULE

Use the drawing below to give the measures (in lowest terms) indicated by the letters.


1.
2.
3.
4.
5.
6.
7.
8
16
1
2
3
4
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

13.

14.

15.

16.

17.

BASIC MEASUREMENT
UNIT I

ASSIGNMENT SHEET #2a--Line Measurement

1. Measure these lines to the nearest eighth of an inch.

a. ______________________________

b. ____

c. _________

d. __________________

e. ____

f. _______________________

g. ________________________________

h. ______________________________________

2. Measure these lines to the nearest sixteenth of an inch.

a. ____

b. ________

c. ________________________

d. ______________________________

e. ____

f. ________________________________

g. __________________

h. _____________________________________

i. _________________________

j. ________________________________

k. ______________________________________

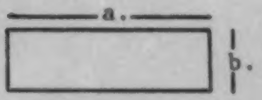
l. ______________

BASIC MEASUREMENT
UNIT I

ASSIGNMENT SHEET #2b--OBJECT MEASUREMENT

Use a 1/16 inch scale rule to measure the following objects.

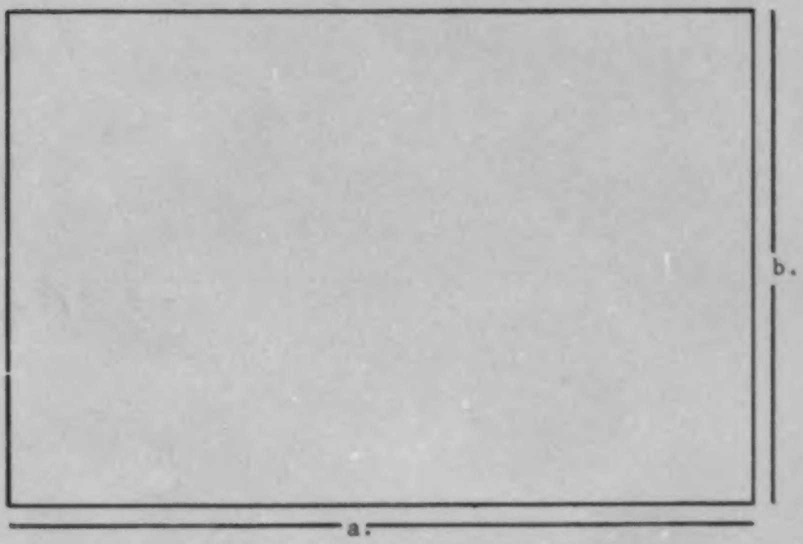
1.



a.

b.

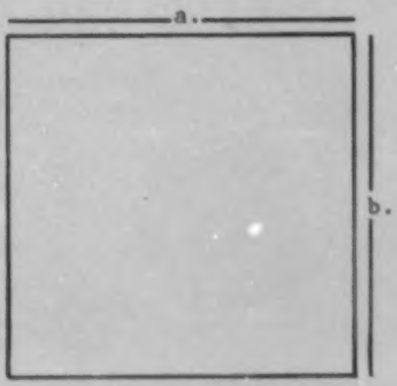
2.



a.

b.

3.

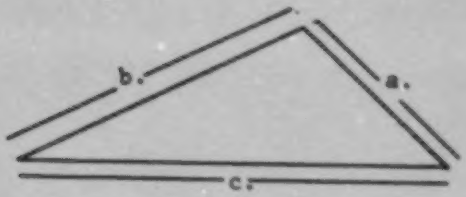


a.

b.

ASSIGNMENT SHEET #2b

4.

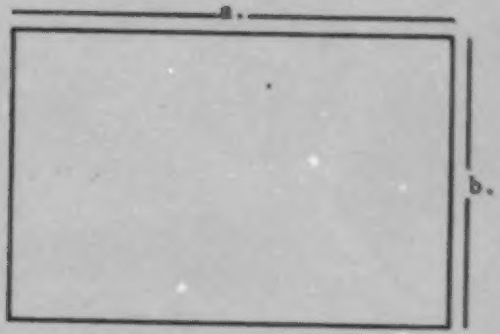


a.

b.

c.

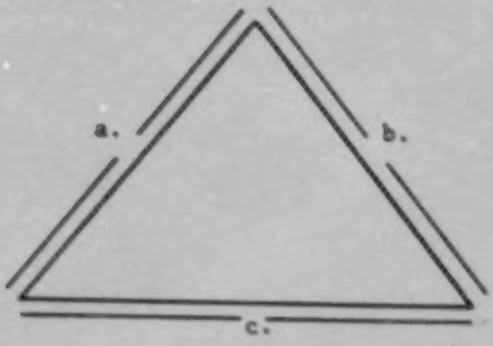
5.



a.

b.

6.



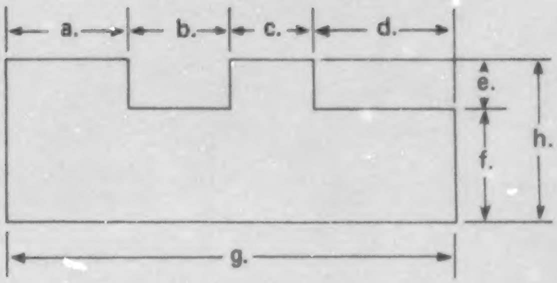
a.

b.

c.

ASSIGNMENT SHEET #2b

7.



a.

b.

c.

d.

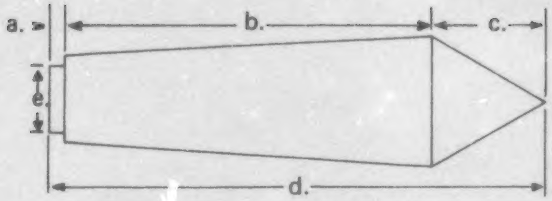
e.

f.

g.

h.

8.



a.

b.

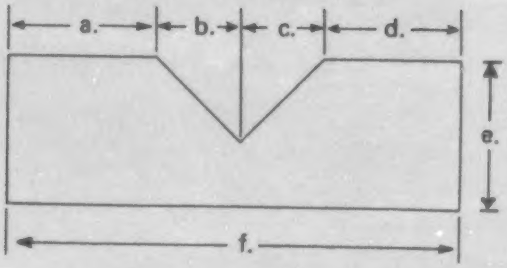
c.

d.

e.

ASSIGNMENT SHEET #2b

9.



a.

b.

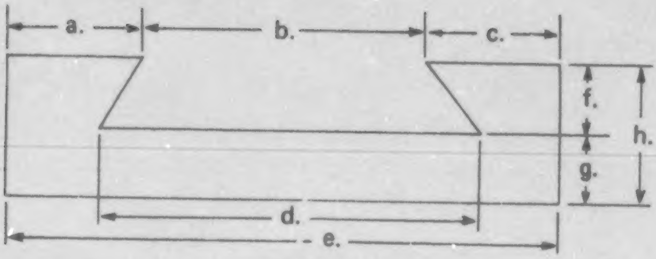
c.

d.

e.

f.

10.



a.

b.

c.

d.

e.

f.

g.

h.

BASIC MEASUREMENT
UNIT I

ASSIGNMENT SHEET #3--LINE CONSTRUCTION

With the rule, construct straight lines of the following lengths.

1. 2 1/4 inches
2. 3 3/4 inches
3. 4 1/2 inches
4. 1 1/8 inches
5. 2 5/8 inches
6. 4 3/8 inches
7. 5 7/8 inches
8. 2 1/16 inches
9. 4 5/16 inches
10. 5 9/16 inches
11. 3 15/16 inches
12. 5 3/4 inches
13. 1 3/16 inches
14. 2 7/16 inches
15. 1 9/16 inches
16. 3 3/8 inches
17. 4 11/16 inches
18. 2 13/16 inches

BASIC MEASUREMENT
UNIT I

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

1. 5/8"
2. 7/8"
3. 1 3/8"
4. 1 3/4"
5. 2 3/8"
6. 2 3/4"
7. 3 5/8"
8. 3/16"
9. 13/16"
10. 1 3/16"
11. 1 9/16"
12. 1 15/16"
13. 2 5/16"
14. 2 3/4"
15. 2 15/16"
16. 3 7/16"
17. 3 13/16"

Assignment Sheet #2a

1. a. 3 1/4"
   b. 4 1/2"
   c. 1"
   d. 2"

e. 4 7/8"
f. 2 1/2"
g. 3 5/8"
h. 4 1/4"

2. a. 4 5/8"
b. 1 1/16"
c. 2 5/8"
d. 3 1/4"
e. 4 7/8"
f. 3 7/8"
g. 2"
h. 4"
i. 2 3/4"
j. 3 1/2"
k. 4 1/8"
l. 1 1/2"

Assignment Sheet #2b

1. a. 1 3/16"
b. 3/8"

2. a. 4 3/8"
b. 2 7/8"

3. a. 2"
b. 2"

4. a. 1 3/16"
b. 1 13/16"
c. 2 1/2"

5. a. 2 9/16"
b. 1 11/16"

6. a. 2 1/8"
   b. 2 1/16"
   c. 2 5/8"

7. a. 11/16"
   b. 9/16"
   c. 1/2"
   d. 13/16"
   e. 1/4"
   f. 11/16"
   g. 2 5/8"
   h. 15/16"

8. a. 1/16"
   b. 2 1/8"
   c. 5/8"
   d. 2 7/8"
   e. 3/8"

9. a. 7/8"
   b. 1/2"
   c. 1/2"
   d. 13/16"
   e. 7/8"
   f. 2 5/8"

10. a. 13/16"
    b. 1 5/8"
    c. 3/4"
    d. 2 3/16"
    e. 3 3/16"
    f. 3/8"
    g. 3/8"
    h. 3/4"

Assignment Sheet #3

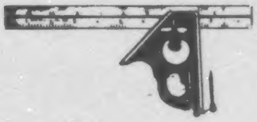
Instructor evaluation

BASIC MEASUREMENT
UNIT I

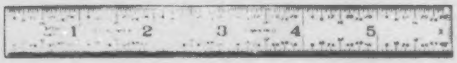
TEST

1. Identify these measuring tools.

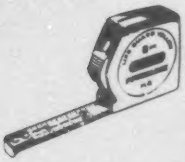
   a.

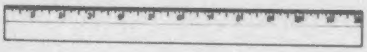


   b.

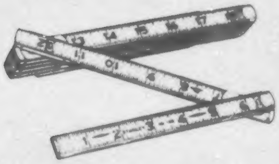


   c.





   d.



   e.

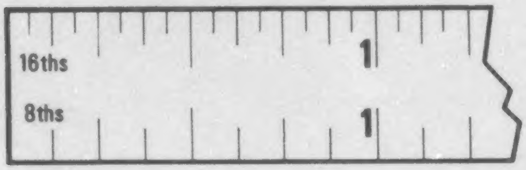
2. Match these units of measurement with the rule that measures each of them.

_____a. Decimal

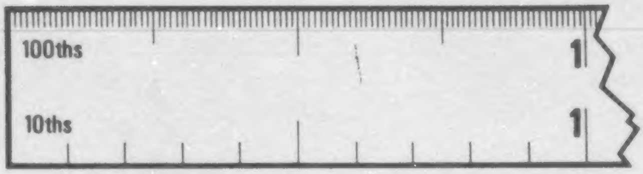
_____b. Fractional

_____c. Metric

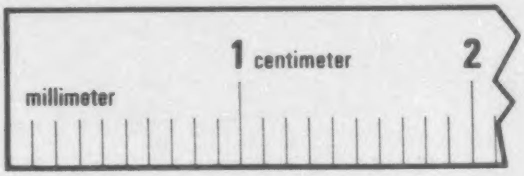
1.


16ths
1
8ths
1

2.

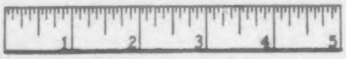

100ths
1
10ths
1

3.

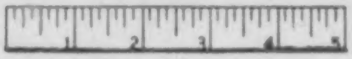

1 centimeter
2
millimeter

3. Classify the rules below as either 1/8 inch scale, 1/16 inch scale, or 1/32 inch scale.

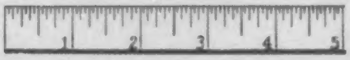
a.



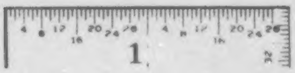
b.



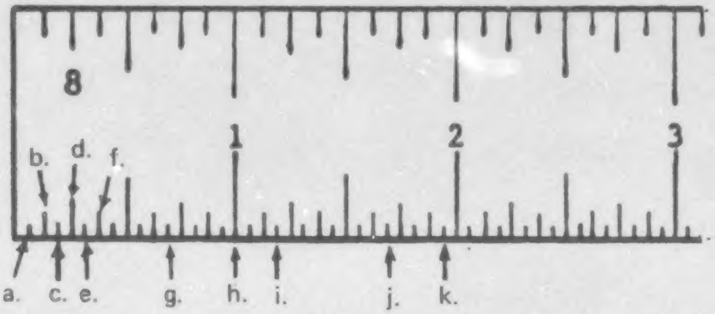
c.



d.



4. Read the rule below and give the measure (in lowest terms) for each point indicated.


8
1
2
3
b.
d.
f.
a.
c.
e.
g.
h.
i.
j.
k.

a.

b.

c.

d.

e.

f.

g.

h.

i.

j.

k.

5. Measure the following lines to the nearest 1/16th inch.

a. ____

b. ____

c. ____

d. ________________________

e. ____

6. Construct lines of the given lengths.

a. 3 1/2"

b. 2 5/8"

c. 4 7/16"

d. 1 3/4"

e. 5 3/8"

BASIC MEASUREMENT
UNIT I

ANSWERS TO TEST

1. a. Combination square
   b. Steel rule
   c. Steel tape
   d. Yard stick
   e. Zig-zag rule
2. a. 2
   b. 1
   c. 3
3. a. 1/16
   b. 1/8
   c. 1/16
   d. 1/32
4. a. 1/16"
   b. 1/8"
   c. 3/16"
   d. 1/4"
   e. 5/16"
   f. 3/8"
   g. 11/16"
   h. 1"
   i. 1 3/16"
   j. 1 11/16"
   k. 1 15/16"

5. a. 3 11/16"
   b. 4 7/8"
   c. 5 1/8"
   d. 2 1/4"
   e. 4 3/4"
6. Instructor should measure each line for correct length.

BLUEPRINT READING
UNIT II

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to identify parts of a pictorial view as used on a blueprint. He should be able to demonstrate the fundamentals of blueprint reading by drawing a three-view sketch of a specified rectangular block. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Indicate in writing the purpose of a blueprint.
2. Match the three major views of a drawing with the correct name of each.
3. Match the three basic elements of a blueprint with their purposes.
4. Match the basic types of dimensions with their uses and identify these dimensions on a blueprint drawing.
5. Match six lines with the correct type of line and identify seven common types of lines on a blueprint drawing.
6. Match fifteen blueprint abbreviations with their corresponding identifications.
7. Draw a simple three-view sketch of a rectangular block, using the following dimensions: eight inches long by one inch wide by one-half inch thick.

BLUEPRINT READING
UNIT II

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with objective sheet.

  B. Provide each student with information and assignment sheets.

  C. Make transparencies.

  D. Discuss terminal and specific objectives.

  E. Discuss information and assignment sheets.

  F. Give test.

II. Students:

  A. Read objectives.

  B. Study information sheet.

  C. Obtain drawing paper, ruler, and tri-square protractor to be used in drawing plans.

  D. Complete assignment sheet.

  E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objectives

  B. Information sheet

  C. Transparency masters

    1. TM 1--Converting a Pictorial View into a Three-Sided View

    2. TM 2--Types of Dimensions on a Blueprint

    3. TM 3--Basic Lines Used in Blueprint Reading

    4. TM 4--Use of Lines on a Blueprint Reading

D. Assignment Sheet #1--Draw a Three-View Sketch

E. Test

F. Answers to test

II. References:

A. Bennett, A. E., and Louis J. Siy, *Blueprint Readi*
New York: Delmar Publishers, Inc., 1960.

B. Sacks, Raymond. *Theory and Practice of Arc We*
Nostrand Reinhold Company, 1960.

C. *How to Read Shop Drawings.* Cleveland, Ohio
Company, 1961.

a Three-View Sketch

Siy, *Blueprint Reading for Welders.* Albany,
rs, Inc., 1960.

d Practice of Arc Welding. New York: Van
, 1960.

ngs. Cleveland, Ohio: The Lincoln Electric

BLUEPRINT READING
UNIT II

INFORMATION SHEET

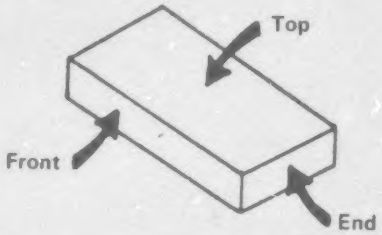
I. Purpose of blueprint--To convey a message from the draftsman to the workman indicating shapes and dimensions of objects to be built

II. Major views of a drawing (Transparency 1)

   A. Top

   B. Front

   C. End



III. Basic elements of a blueprint

   A. Lines--Give shape and dimension to the object

   B. Dimensions--Give size and location of various segments of items being constructed

   C. Notes--Give details of construction not shown by lines

IV. Types of dimensions (Transparency 2)

   A. Overall--Describes a total distance such as the complete length, width, or thickness of a part

   B. Size--Gives information concerning the size of a part

   C. Location--Gives information concerning the location of some detail of construction such as a hole

V. Basic lines used in blueprint reading (Transparencies 3 and 4)

   A. Border line--Serves as a frame for the blueprint

   B. Object line--Indicates the outline of an object

   C. Hidden line--Represents an edge that cannot be seen from the outside of the object

   D. Extension line--Indicates the exact distance the dimension describes

INFORMATION SHEET

E. Dimension line--Extends between the extension lines to clarify dimensions

F. Center line--Used to locate the center of a circle or a curved surface

G. Pointer line--Shows the detail described by a dimension or note

H Cutting plane line--Used to show the shape of complicated parts

I. Break line--Used to show interior detail

VI. Common abbreviations used on blueprints

A. C. I.--Cast Iron

B. C. C.--Center to Center

C. C. Bore--Counterbore

D. C. R. S.--Cold Rolled Steel

E. C. S.--Cast Steel

F. Csk.--Countersink

G. Dia.--Diameter

H. F--Finish

I. F. A. O.--Finish All Over

J. Fin--Finish

K. F. S.--Full Size

L. F. S. D.--Full Size Detail

M. Hex--Hexagon

N. I. D.--Inside Diameter

O. N. C.--National Coarse

P. N. F.--National Fine

Q. No. or #--Number

R. O. C.--On Center

S. O. D.--Outside Diameter

T. R. or Rad--Radius

U. Req'd--Required

INFORMATION SHEET

V. S. A. E.--Society of Automotive Engineers

W. Sq.--Square

X. U. S. S.--United States Standard

Y. N. T. S.--Not to Scale

Z. Cir--Circular

AA. Cyl--Cylinder

BB. Deg or °--Degree(s)

CC. Ga--Gauge

DD. GI--Galvanized Iron

EE. I--I Beam

FF. In. or "--Inch(es)

GG. Mal I--Malleable Iron

HH. Std--Standard

II. Stl--Steel

JJ. Stl C--Steel Casting

KK. Thd or Thds--Thread(s)

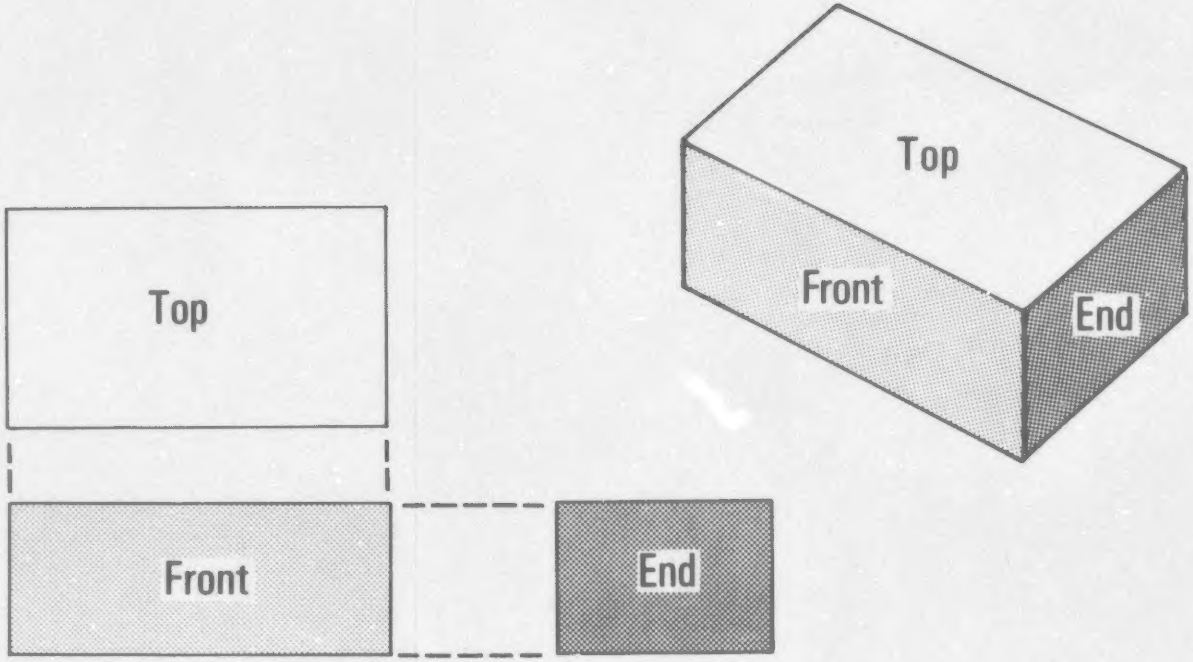
LL. WI--Wrought Iron

MM. Br#--Brass, SAE#

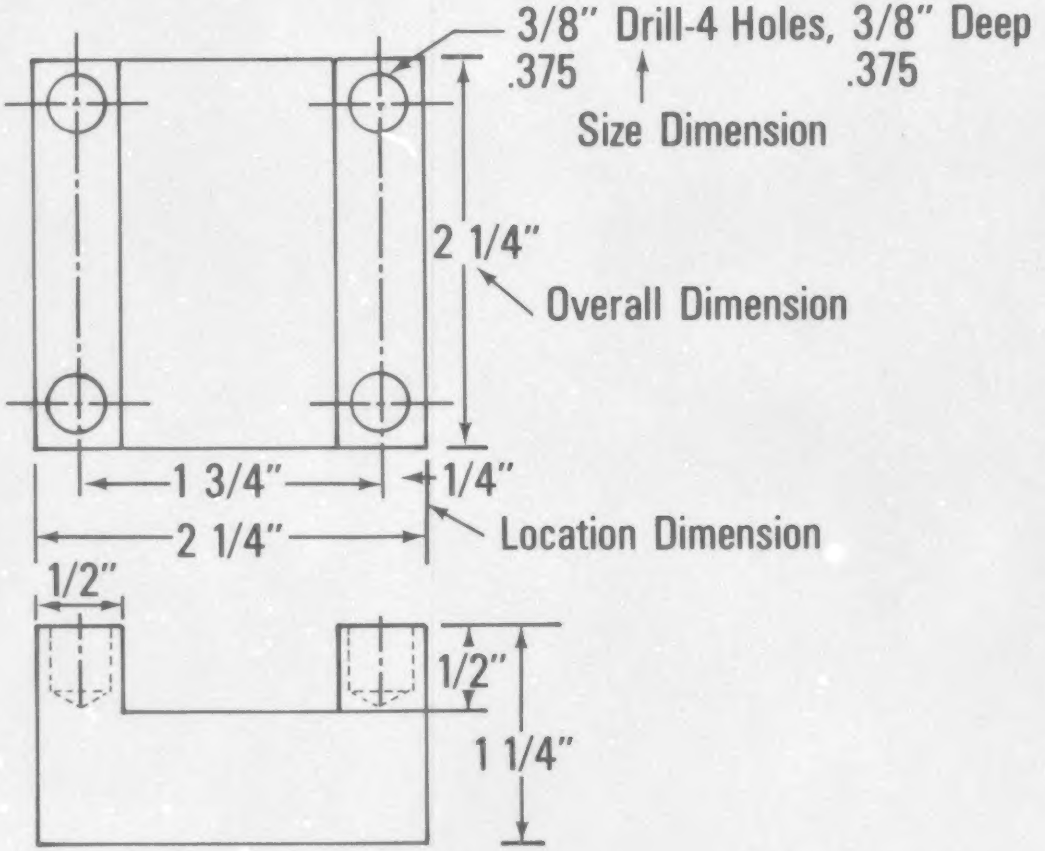
NN. Bro#--Bronze, SAE#

OO. Chfr--Chamfer

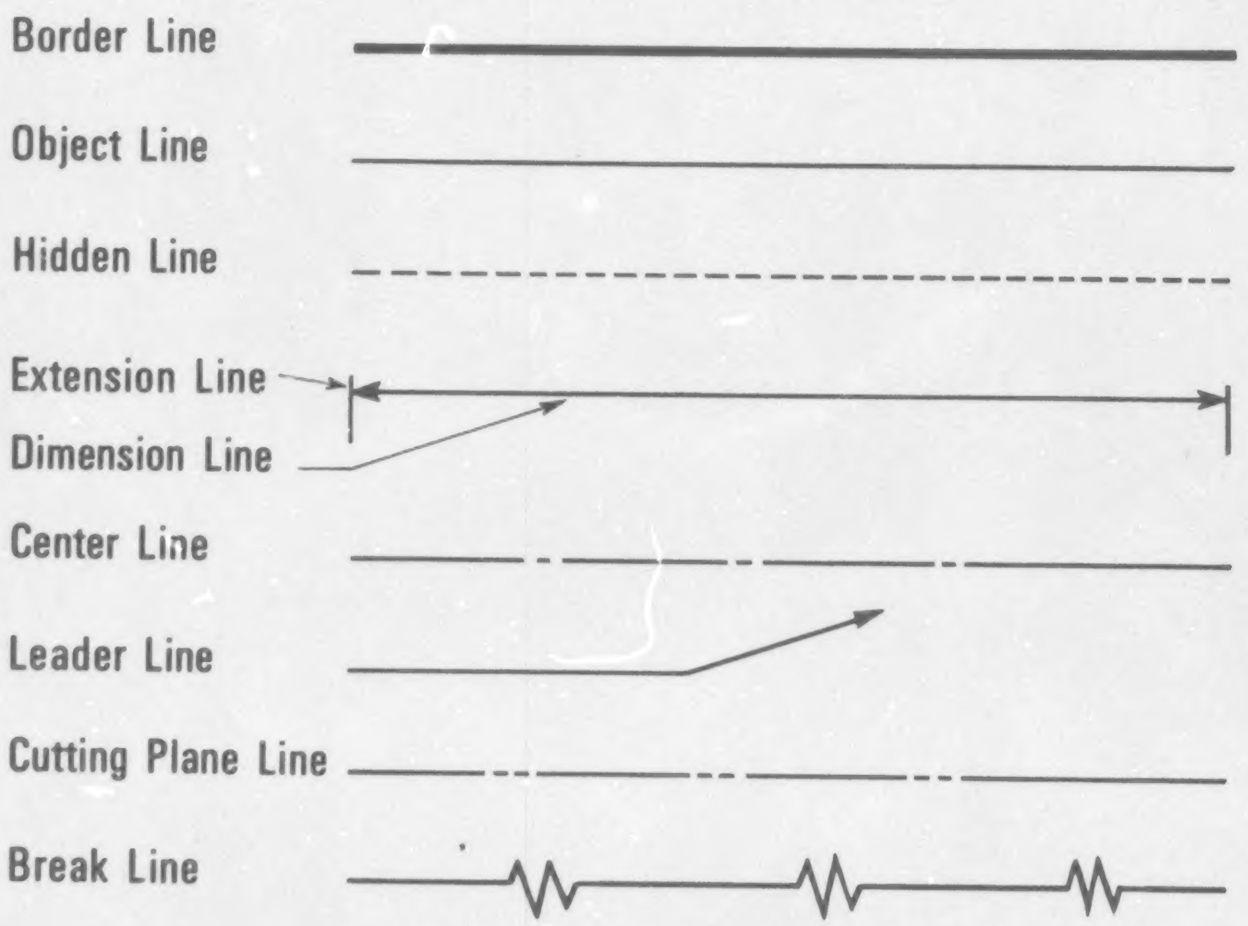
Converting a Pictorial View into a Three-Sided View


Top
Front
End
Top
Front
End

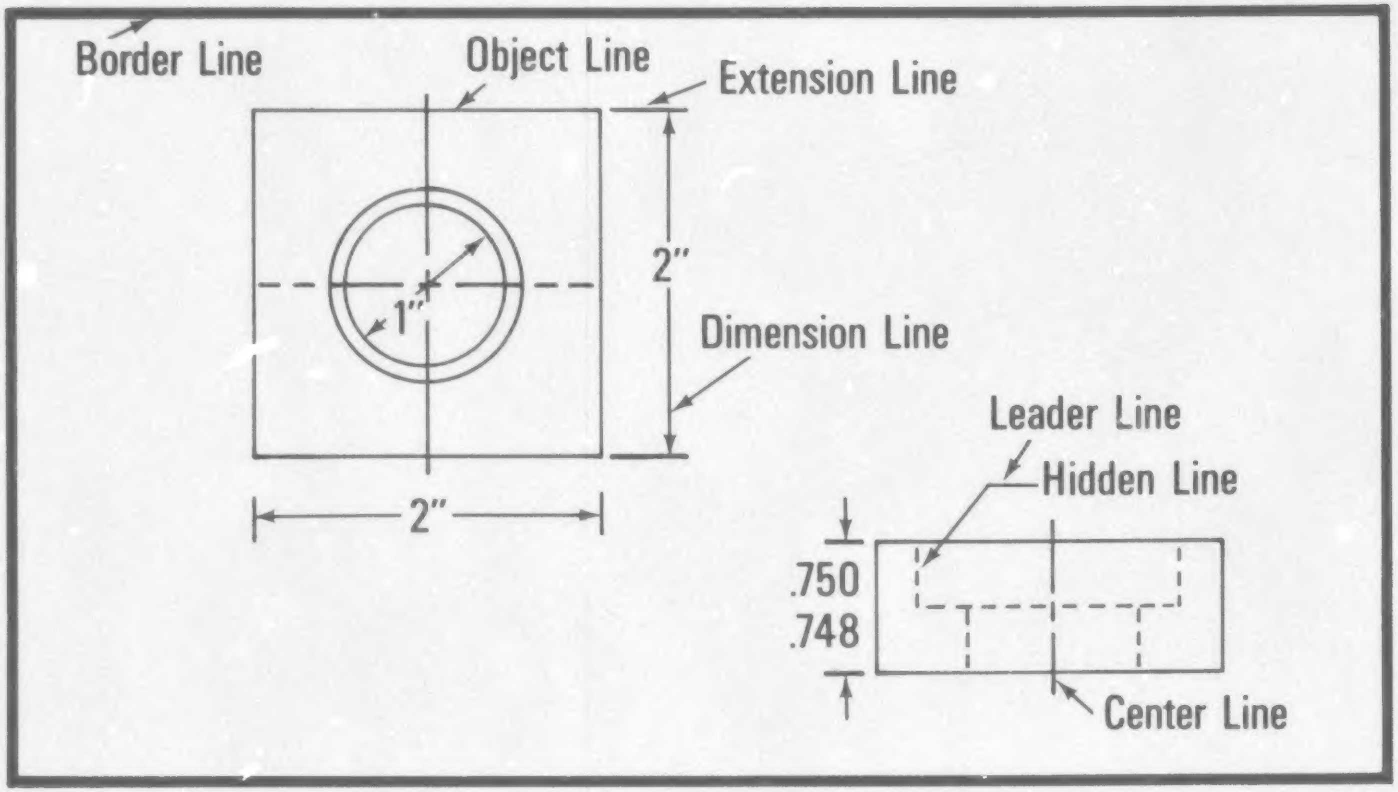
Types of Dimensions on a Blueprint


3/8" Drill-4 Holes, 3/8" Deep
.375
.375
Size Dimension
2 1/4"
Overall Dimension
1 3/4"
1/4"
2 1/4"
Location Dimension
1/2"
1/2"
1 1/4"

BASIC LINES USED IN BLUEPRINT READING


Border Line
Object Line
Hidden Line
Extension Line
Dimension Line
Center Line
Leader Line
Cutting Plane Line
Break Line

Use of Lines on a Blueprint Reading


Border Line
Object Line
Extension Line
2"
1"
Dimension Line
2"
Leader Line
Hidden Line
.750
.748
Center Line

BLUEPRINT READING
UNIT II

ASSIGNMENT SHEET #1--DRAW A THREE-VIEW SKETCH

Draw a three-view sketch of a rectangular block using the following dimensions. Be sure to show your dimensions.

1. 10" long by 2" wide by 1" thick.

2. 12" long by 1" wide by 1/4 " thick.

BLUEPRINT READING
UNIT II

TEST

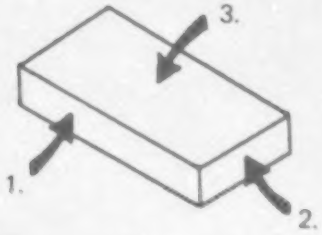
1. Write the purpose of a blueprint for a workman.

2. Match the three major views of a drawing with the correct name of the view.

______a. Top

______b. Front

______c. End



3. Match the basic elements of a blueprint with their purposes.

______a. Lines

______b. Dimensions

______c. Notes

1. Give details of construction not shown by lines
2. Give shape and dimension to the object
3. Give size and location of various segments of items being constructed

4. a. Match the basic type of dimension with its proper function.

______1) Location dimension

______2) Overall dimension

______3) Size

a. Gives information concerning the size of a part

b. Gives information concerning the location of some detail of construction such as a hole

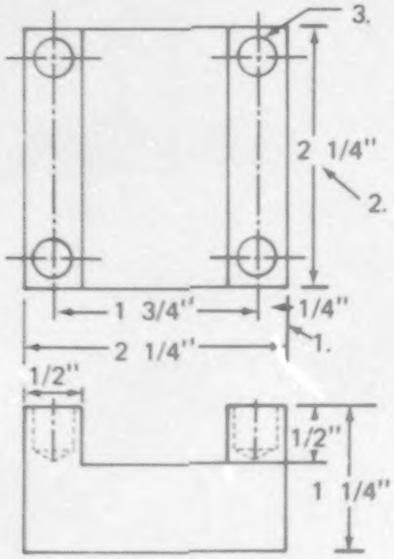
c. Describes a total distance such as the complete length, width, or thickness of a part

b. Correctly identify the basic types of dimensions on the following blueprint drawing.

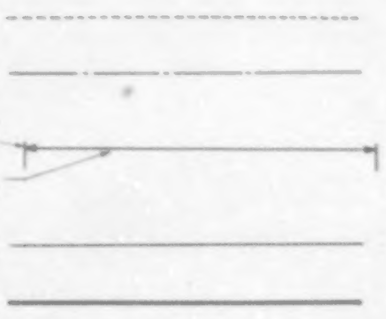
1) ________________

2) ________________

3) ________________


3.
2 1/4"
2.
1 3/4"
1/4"
1.
2 1/4"
1/2"
1/2"
1 1/4"

5. a. Match the following lines with the correct type of line.



______ 1) a) Border

______ 2) b) Center

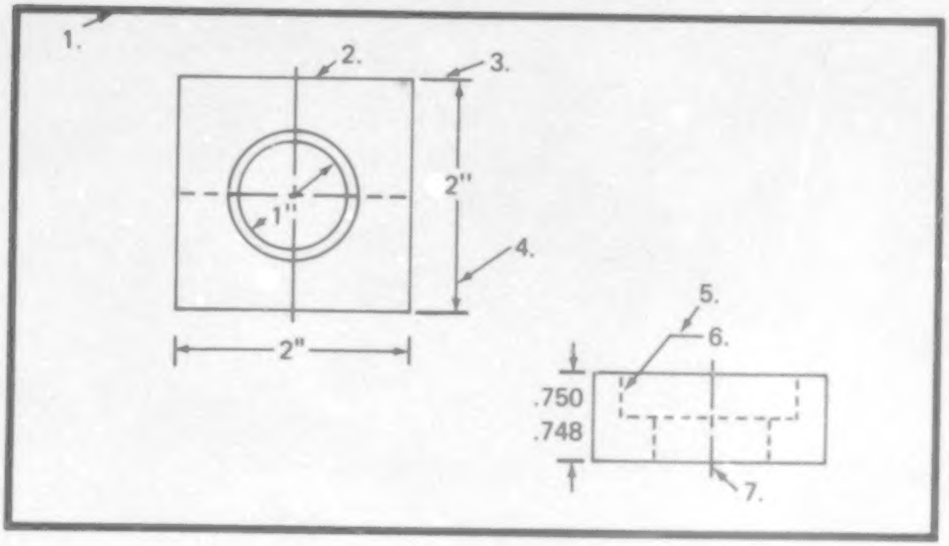
______ 3) c) Dimension

______ 4) d) Extension

______ 5) e) Hidden

______ 6) f) Object

b. Correctly identify the common lines on the following blueprint drawing.



1)________________

2)________________

3)________________

4)________________

5)________________

6)________________

7)________________

6. Match the following abbreviations with the correct identification.

_____a.	Std	1.	Finish
_____b.	Csk.	2.	Thread
_____c.	O. D.	3.	Chamfer
_____d.	Mal I	4.	Bronze, SAE#
_____e.	Hex	5.	Steel
_____f.	Cyl	6.	Brass, SAE#

______g. Br#

______h. Stl

______i. Sq.

______j. Chfr

______k. Deg

______l. Cir

______m. Fin

______n. R.

______o. N. C.

7. Wrought Iron

8. Galvanized Iron

9. Circular

10. Radius

11. Standard

12. National Coarse

13. Hexagon

14. Degree

15. Square

16. Countersink

17. Outside Diameter

18. Cylinder

19. Malleable Iron

20. Cast Steel

7. Draw a simple three-view sketch of a rectangular block using the following directions: eight inches long by one inch wide by one-half inch thick.

BLUEPRINT READING
UNIT II

ANSWERS TO TEST

1. To convey a message from the draftsman to the workman indicating shapes and dimensions of objects to be built

2. a. 3
   b. 1
   c. 2

3. a. 2
   b. 3
   c. 1

4. a. 1) b
      2) c
      3) a
   b. 1) Location dimension
      2) Overall dimension
      3) Size

5. a. 1) e
      2) b
      3) d
      4) c
      5) f
      6) a
   b. 1) Border line
      2) Object line
      3) Extension line

4) Dimension line

5) Leader line

6) Hidden line

7) Center line

6. a. 11

b. 16

c. 17

d. 19

e. 13

f. 18

g. 6

h. 5

i. 15

j. 3

k. 14

l. 9

m. 1

n. 10

o. 12

7. Evaluated to the satisfaction of the instructor.

GAS WELDING
UNIT I

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to set up, light, adjust, and turn off oxyacetylene cutting equipment following the proper order and safety precautions. This knowledge will be evidenced through demonstration and by scoring one hundred percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Discuss briefly the reasons for the welding safety rules given on the test.
2. Match the names with the correct parts of an oxyacetylene unit, cutting torch, and accessories.
3. Distinguish between an oxygen and an acetylene hose connection.
4. Match the names with the correct types of oxyacetylene cutting flames.
5. Demonstrate with one-hundred percent accuracy the ability to:
    a. Set up equipment for oxyacetylene cutting.
    b. Turn on, light, and adjust to a neutral flame the oxyacetylene cutting equipment and properly turn off the cutting flame and oxyacetylene equipment.
    c. Produce the three types of cutting flames.

GAS WELDING
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Make transparencies.

   D. Discuss terminal and specific objectives.

   E. Discuss information sheet.

   F. Demonstrate and discuss procedures outlined in the job sheets.

   G. Give test.

II. Students:

   A. Read objectives.

   B. Study information sheet.

   C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objectives

   B. Information sheet

   C. Transparency masters

      1. TM 1--Oxyacetylene Cutting Equipment

      2. TM 2--Welding Regulators

      3. TM 3--Types of Oxyacetylene Cutting Flames

D. Job sheets

1. Job Sheet #1--Set Up Equipment for Oxyacetylene Cutting

2. Job Sheet #2--Turn On, Light, and Adjust the Cutting Torch to a Neutral Flame and Turn Off the Flame

3. Job Sheet #3--Produce the Three Types of Cutting Flames

E. Test

F. Answers to test

II. References:

A. *Smith's Instructor's Manual for a Basic Course in Oxyacetylene Brazing, Cutting, and Welding (Form 424)*. Minneapolis, Minnesota: Smith Welding Equipment, Division of Tescom Corporation, 1967.

B. *Smith's Short Course for Gas Cutting, Welding, and Brazing*. Minneapolis, Minnesota: Smith Welding Equipment, Division of Tescom Corporation, 1963.

C. Phipps, Lloyd J., J. F. McColby, L. L. Scranton, and G. C. Cook. *Farm Mechanics Text and Handbook*. Danville, Illinois: Interstate Publishers and Printers, 1959.

D. *OXY-LP Gas Flame Traits* (Smith's Form 23b). Minneapolis, Minnesota: Smith Welding Equipment Division of Tescom Corporation.

E. Althouse, Andrew D., Carl H. Turnquist, and William A. Bowditch. *Modern Welding*. Homewood, Illinois: The Goodheart-Willcox Company, Inc., 1965.

GAS WELDING
UNIT I

INFORMATION SHEET

I. Safety rules

A. Support oxygen and acetylene cylinders in an upright position so they cannot be tipped over; acetylene gas is in a liquid state in the cylinder and should be used in a vertical position so that acetone will not be withdrawn

B. Blow out cylinder valves (crack valve for a second) before attaching regulators in order to remove dust and dirt

C. Release adjusting screw on regulator before opening cylinder valve in order to prevent damage to regulators and possible injury to operator

D. Stand to the side of regulators keeping the cylinder valve between operator and regulator when opening cylinder valves

E. Open cylinder valves slowly

F. Do not use acetylene (in free state) at pressures higher than 15 psi; acetylene becomes unstable at pressures above 15 psi

G. Purge oxygen and acetylene passages (individually) before lighting torch

H. Light acetylene before opening oxygen preheat valve on torch

I. Never use oil or grease on regulators, torches, fittings, etc.; oil or grease and oxygen have a very great attraction for one another and will combine with explosive violence

J. Do not use oxygen as a substitute for compressed air

K. Use safety goggles, gloves, and coveralls

L. Have CO_2 or dry powder type fire extinguisher available

M. Test connections for leaks with ivory soap suds, paint brush, and water

N. Avoid lighting torch or cutting near combustible materials

O. Never open the acetylene cylinder valve more than 1 1/2 turns

P. Always operate torch in a well-ventilated area

Q. Never cut on containers that have been used for combustible materials

R. Avoid breathing toxic fumes when cutting

Example: Galvanized metal

INFORMATION SHEET

- S. Place steel caps on all gas cylinders when they are being moved or stored to protect the valves
- T. Shut off cylinder valves when not in use for any length of time to reduce the possibility of leakage and strain on the equipment
- U. Turn acetylene torch valve off first in order that the flame will go out immediately
- V. Keep hands, gloves, and clothing free from oil and grease

II. Oxyacetylene cutting equipment (Transparencies 1 and 2)

- A. Acetylene cylinder
- B. Acetylene cylinder valve
- C. Acetylene fitting
- D. Acetylene regulator
- E. Acetylene torch valve
- F. Cylinder truck
- G. Flint lighter
- H. Oxygen cutting lever
- I. Oxygen cylinder
- J. Oxygen cylinder valve
- K. Oxygen fitting
- L. Oxygen pre-heat valve
- M. Oxygen regulator
- N. Oxygen torch valve
- O. Safety chain
- P. Slip-in tip
- Q. Tip nut
- R. Torch body
- S. Welding gloves
- T. Welding goggles

INFORMATION SHEET

III. Hose connections

A. Oxygen hose

1. Green

2. Oxygen fitting with right-hand threads

B. Acetylene hose

1. Red

2. Grooved nut acetylene fitting with grooved left-hand threads

IV. Types of cutting flames (Transparency 3)

A. Carburizing flame

1. Burns excess of acetylene (Acetylene feather is visible on inner cone.)

2. Recommended flame for cutting cast iron

3. Introduces carbon into weld causing hardening of the metal (Resultant weld is weak.)

B. Neutral flame

1. Burns equal amounts of oxygen and acetylene

2. Identified by clear, well-defined white cone

3. Temperature 5950°

C. Oxidizing flame

1. Burns excess of oxygen

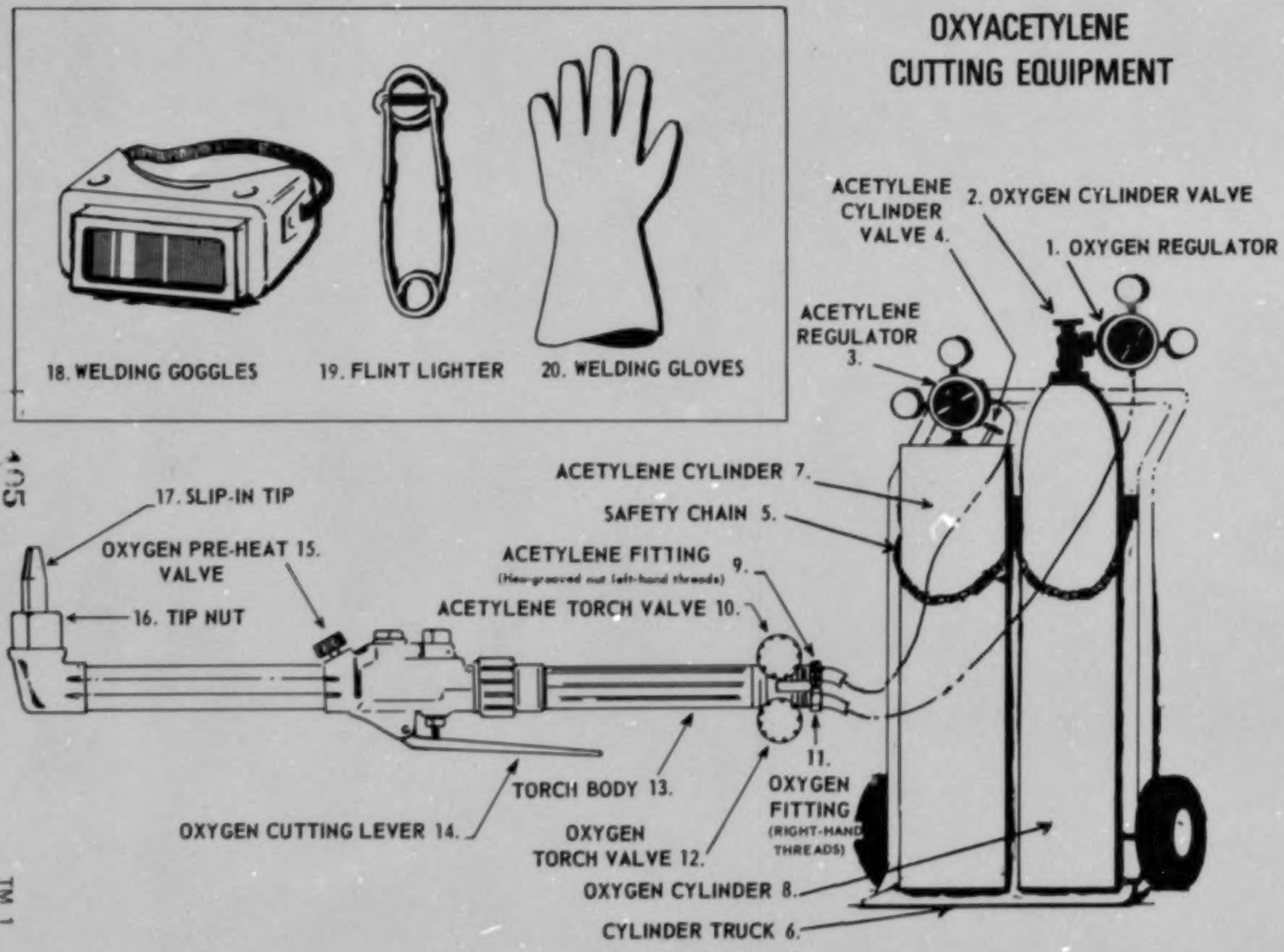
2. Identified by short white inner cone

3. Oxidizes the metal causing it to harden and become brittle

4. Not recommended for average cutting

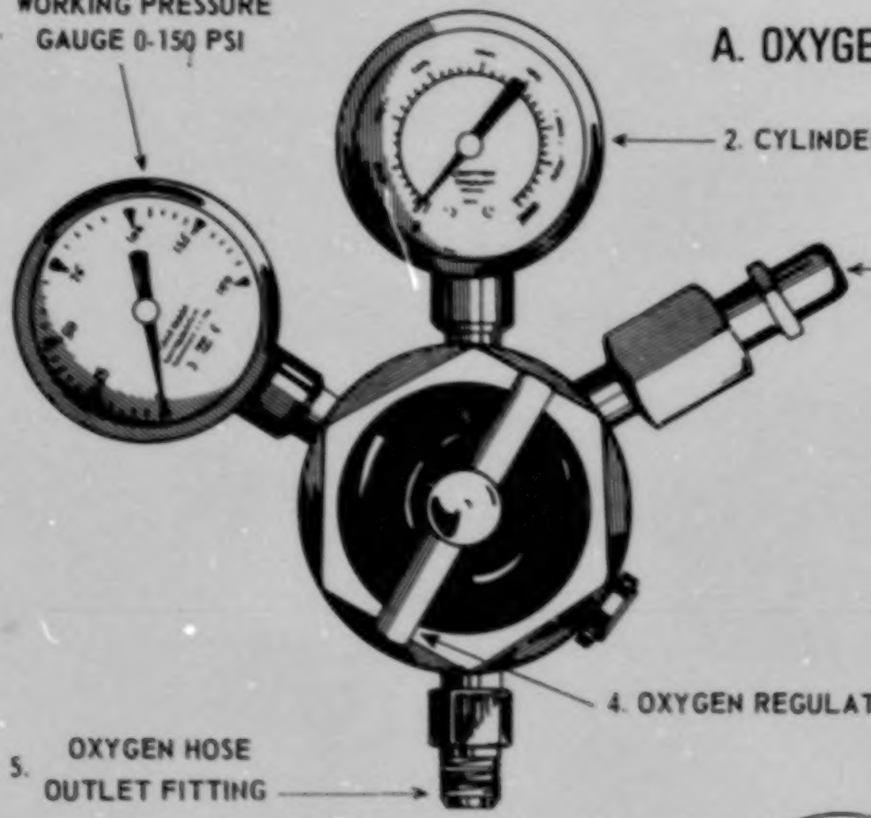
5. Is the hottest flame

OXYACETYLENE CUTTING EQUIPMENT

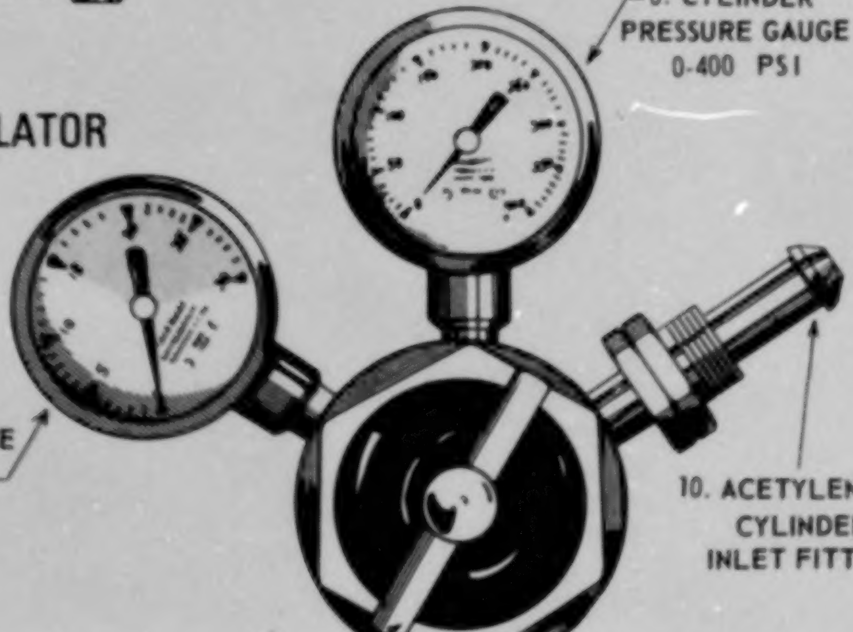

18. WELDING GOGGLES
19. FLINT LIGHTER
20. WELDING GLOVES
ACETYLENE CYLINDER VALVE 4.
2. OXYGEN CYLINDER VALVE
1. OXYGEN REGULATOR
ACETYLENE REGULATOR 3.
ACETYLENE CYLINDER 7.
SAFETY CHAIN 5.
17. SLIP-IN TIP
OXYGEN PRE-HEAT 15. VALVE
ACETYLENE FITTING 9.
(Hex-grooved nut left-hand threads)
ACETYLENE TORCH VALVE 10.
16. TIP NUT
11. OXYGEN FITTING (RIGHT-HAND THREADS)
TORCH BODY 13.
OXYGEN CUTTING LEVER 14.
OXYGEN TORCH VALVE 12.
OXYGEN CYLINDER 8.
CYLINDER TRUCK 6.

WELDING REGULATORS

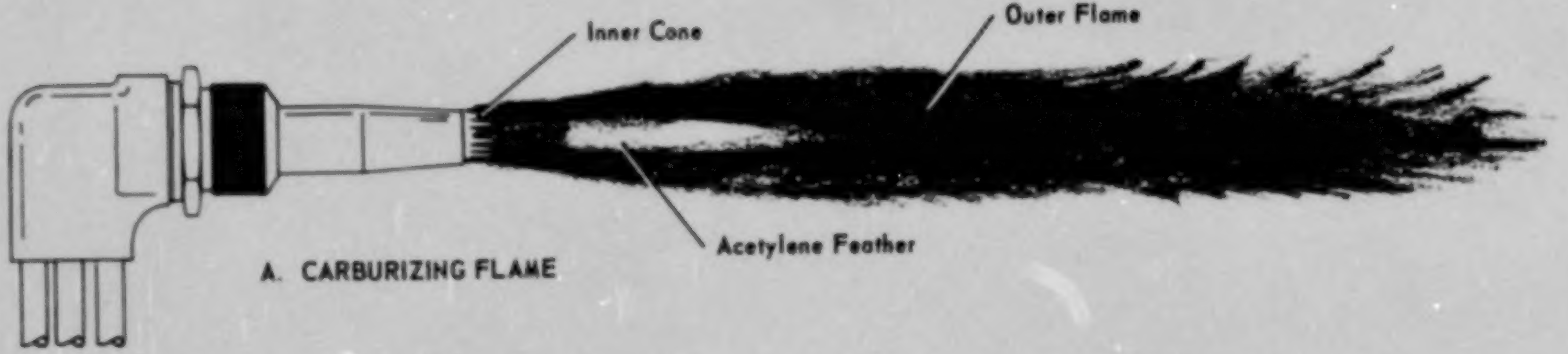
A. OXYGEN REGULATOR GAUGES


1. WORKING PRESSURE GAUGE 0-150 PSI
2. CYLINDER PRESSURE GAUGE 0 to 3000 PSI
3. OXYGEN CYLINDER INLET FITTING
4. OXYGEN REGULATOR ADJUSTING SCREW
5. OXYGEN HOSE OUTLET FITTING

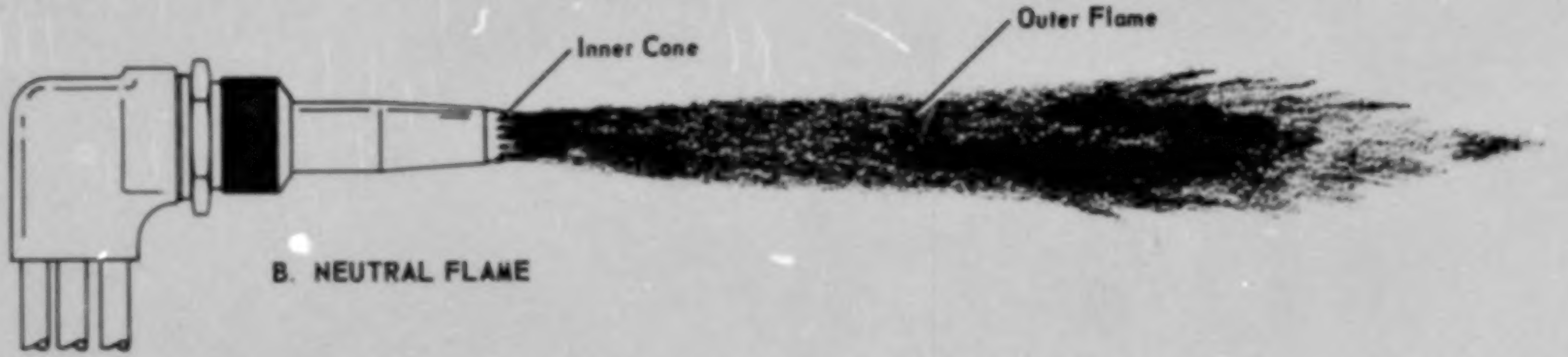
B. ACETYLENE REGULATOR


6. CYLINDER PRESSURE GAUGE 0-400 PSI
7. WORKING PRESSURE GAUGE 0 TO 30 PSI
8. ACETYLENE REGULATOR ADJUSTING SCREW
9. ACETYLENE HOSE OUTLET FITTING
10. ACETYLENE CYLINDER INLET FITTING

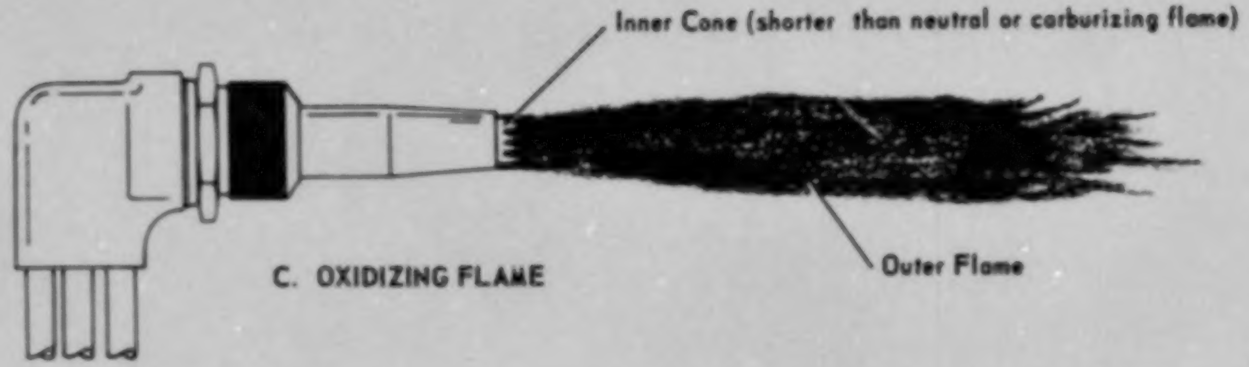
TYPES OF OXYACETYLENE CUTTING FLAMES


Inner Cone
Outer Flame
Acetylene Feather

A. CARBURIZING FLAME


Inner Cone
Outer Flame

B. NEUTRAL FLAME


Inner Cone (shorter than neutral or carburizing flame)
Outer Flame

C. OXIDIZING FLAME

GAS WELDING
UNIT I

JOB SHEET #1-SET UP EQUIPMENT FOR OXYACETYLENE CUTTING

I. Tools and materials needed

- A. Coveralls
- B. Acetylene cylinder, hose, and regulator
- C. Oxygen cylinder, hose, and regulator
- D. Torch body
- E. Cutting assembly with a number one tip
- F. Wrenches to fit connections
- G. Ivory soap
- H. Can of water
- I. Paint brush

II. Procedure

- A. Fasten cylinders in a vertical position
- B. Remove caps from cylinders
- C. Crack valves of each cylinder then close valves
- D. Connect oxygen regulator to oxygen cylinder
    - 1. Turn adjusting screw on regulator counterclockwise until tension on spring is released
    - 2. Slowly open cylinder valve wide open
- E. Connect acetylene regulator to acetylene cylinder
    - 1. Turn adjusting screw on regulator counterclockwise until tension on spring is released
    - 2. Open cylinder valve 1/2 to 3/4 of a turn (never more than 1 1/2 turns)
- F. Connect acetylene hose to acetylene regulator and purge hose

JOB SHEET #1

G. Connect oxygen hose to oxygen regulator and purge hose

H. Connect torch body to oxygen and acetylene hose and close both valves on torch body

I. Attach cutting attachment to torch body (Use a number 1 cutting tip.)

J. Close oxygen preheat valve on cutting attachment

K. Turn adjusting screw on oxygen regulator clockwise until working pressure gauge reads 35 psi

L. Turn adjusting screw on acetylene regulator clockwise until working pressure gauge reads 4 psi

M. Test all connections for leaks with Ivory soap suds and water (Apply soap suds with a clean paint brush.)

GAS WELDING
UNIT I

JOB SHEET #2--TURN ON, LIGHT, AND ADJUST THE CUTTING TORCH TO A NEUTRAL FLAME AND TURN OFF THE FLAME

I. Tools and materials needed

  A. Oxyacetylene equipment as set up on Job Sheet #1

  B. Flint lighter

  C. Coveralls

II. Procedure

  A. Check all cylinder, regulator, and torch valves to make sure they are off

  B. Open acetylene cylinder valve 1/2 to 3/4 of a turn

  (CAUTION: Never open more than 1 1/2 turns)

  C. Open acetylene valve on torch one turn

  D. Turn adjusting screw on acetylene regulator clockwise until desired pressure is reached (determined by size of tip)

  E. Close acetylene valve on torch

  F. Open oxygen cylinder valve all the way

  G. Open oxygen torch valve one turn

  H. Open oxygen preheat valve on cutting attachment one turn

  I. Turn adjusting screw on oxygen regulator clockwise until desired pressure is reached (determined by size of tip)

  J. Close oxygen preheat valve on cutting attachment

  K. Open acetylene valve on torch 1/4 turn

  L. Light the torch with flint lighter and adjust until smoke on flame clears

  M. Open oxygen preheat valve slowly and adjust to a neutral flame

  N. Depress the oxygen cutting lever and check to see that a neutral flame is present

  (NOTE: If necessary, adjust the oxygen preheat valve with the oxygen cutting lever depressed until a neutral flame is secured.)

JOB SHEET #2

III. Procedure for turning off the flame and oxyacetylene unit

A. Close acetylene valve on torch

B. Close oxygen preheat valve

C. Close acetylene cylinder valve

D. Close oxygen cylinder valve

E. Open acetylene valve on torch (When gauges reach 0, close torch valve and release adjusting screw on acetylene regulator by turning counterclockwise.)

F. Open oxygen preheat valve on torch (When gauges reach 0, close oxygen preheat valve and release adjusting screw on oxygen regulator by turning counterclockwise.)

G. Close oxygen valve on torch

H. Place torch and hose on hanger or brackets provided

GAS WELDING
UNIT I

JOB SHEET #3--PRODUCE THE THREE TYPES OF CUTTING FLAMES

I. Tools and materials needed

- A. Oxyacetylene equipment as set up on Job Sheet #1
- B. Flint lighter
- C. Coveralls

II. Procedure

- A. Start with the neutral flame as described on Job Sheet #2
- B. Produce a carburizing flame
    - 1. Reduce the supply of oxygen
    - 2. Slowly adjust the oxygen preheat valve until an acetylene feather is produced
- C. Produce and oxidizing flame
    - 1. Increase the supply of oxygen
    - 2. Adjust the oxygen preheat valve (Result is a flame with an excess of oxygen.)
- D. Adjust to a neutral flame
    - 1. Reduce the oxygen supply
    - 2. Slowly adjust the oxygen preheat valve

GAS WELDING
UNIT I

TEST

1. Discuss briefly the reasons for these welding safety rules.

   a. Acetylene cylinders should always be kept in an upright position.

   b. Place steel caps on all gas cylinders when they are being moved.

   c. Blow out cylinder valves before attaching regulators.

   d. Never use oil or grease on regulators, torches, fittings, etc.

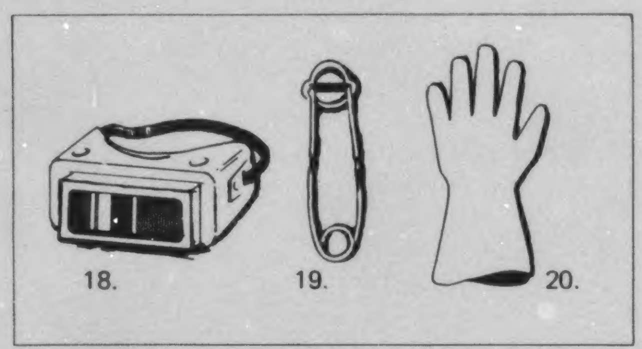
   e. Do not use acetylene at pressures higher than 15 psi.

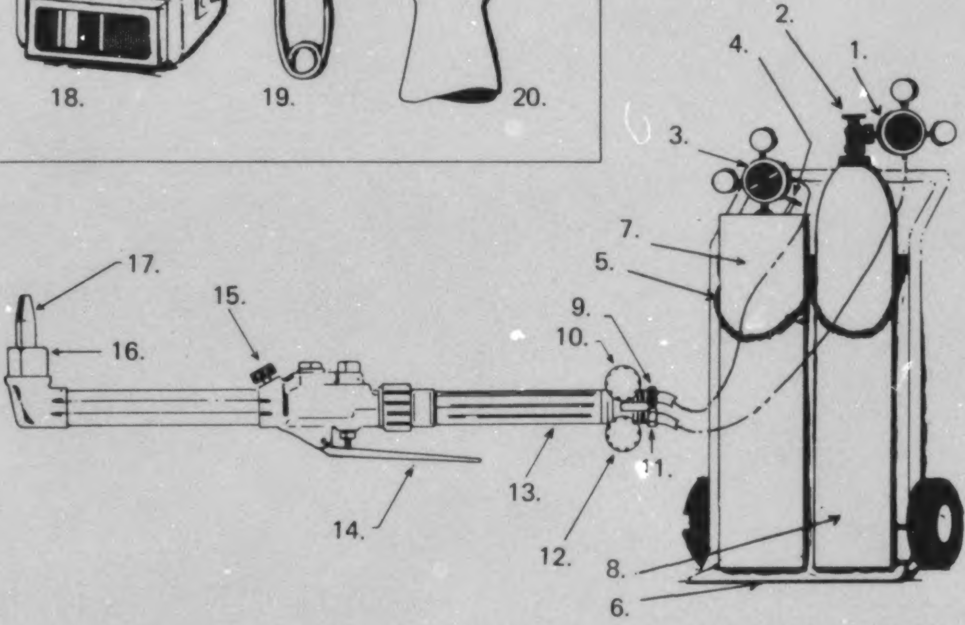
   f. Turn acetylene torch valve off first.

   g. Shut off cylinder valves when not in use for any length of time.

   h. Release the adjusting screw on the regulator before opening the cylinder valve.

2. Match the names with the correct parts of the oxyacetylene equipment.




1.
2.
3.
4.
5.
6.
7.
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9.
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12.
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14.
15.
16.
17.

______a. Acetylene cylinder

______b. Acetylene cylinder valve

______c. Acetylene fitting

______d. Acetylene regulator

______e. Acetylene torch valve

______f. Cylinder truck

______g. Flint lighter

______h. Oxygen cutting lever

______i. Oxygen cylinder

______j. Oxygen cylinder valve

______k. Oxygen fitting

_____l. Oxygen pre-heat valve

_____m. Oxygen regulator

_____n. Oxygen torch valve

_____o. Safety chain

_____p. Slip-in tip

_____q. Tip nut

_____r. Torch body

_____s. Welding gloves

_____t. Welding goggles

3. Which of the following identifies an oxygen hose connection? Place an "X" in the blank.

_____a. Green

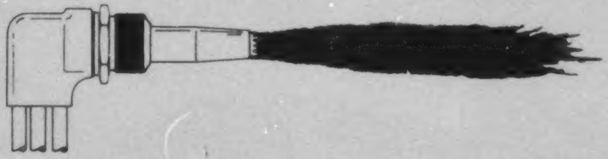
_____b. Grooved nut fitting with left-hand threads

_____c. Red

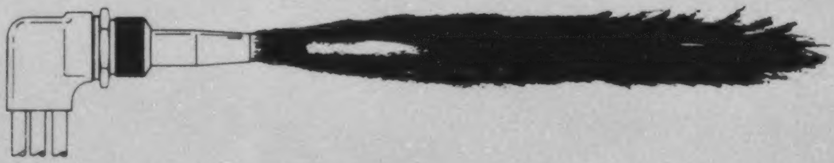
_____d. Fitting with right-hand threads

4. Match the names with the correct type of oxyacetylene cutting flames.

_____a.

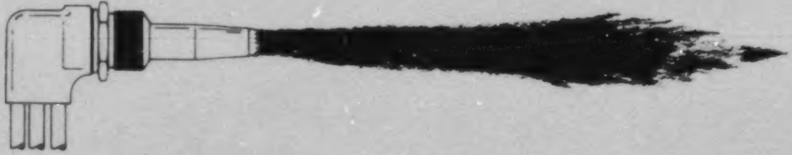


_____b.



(Continued on next page)

_____c.



1. Carburizing flame
2. Neutral flame
3. Oxidizing flame

5. Demonstrate the ability to:

   a. Set up equipment for oxyacetylene cutting.

   b. Turn on, light, and adjust to a neutral flame to oxyacetylene cutting euqipment and properly turn off the cutting flame and oxyacetylene equipment.

   c. Produce the three types of cutting flames.

(NOTE: If this has not been accomplished prior to the test, ask your instructor when the above activities should be completed.)

GAS WELDING
UNIT I

ANSWERS TO TEST

1. The discussion should include these points:

   a. Acetylene gas is in a liquid state in the cylinder and should be used in a vertical position so that acetone will not be withdrawn

   b. Steel caps protect the valves

   c. Blow out the cylinder valve to remove dust and dirt

   d. Oil or grease and oxygen have a very great attraction for one another and will combine with explosive violence

   e. Acetylene becomes unstable at pressures above 15 psi

   f. Turn the acetylene torch valve off first in order that the flame will go out immediately

   g. Shut off cylinder valves to reduce the possibility of leakage and strain on the equipment

   h. Release the adjusting screw to prevent damage to the regulators and possible injury to the operator

2. a. 7

   b. 4

   c. 9

   d. 3

   e. 10

   f. 6

   g. 19

   h. 14

   i. 8

   j. 2

   k. 11

l. 15

m. 1

n. 12

o. 5

p. 17

q. 16

r. 13

s. 20

t. 18

3. a

d

4. a. 3

b. 1

c. 2

5. Performance skills will be evaluated to the satisfaction of the instructor.

USE OF THE CUTTING TORCH
UNIT II

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to select the purposes of a slag box, identify a backfire and flashback and list step by step procedures to follow when a flashback occurs. He should be able to demonstrate the procedures for making a 90° cut and cut holes in mild steel. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match eight terms and definitions associated with cutting of metal.
2. Name the parts of the cutting tip.
3. Select from a list the purposes of a slag box.
4. Select from a list the reasons for poor cuts.
5. Select from a list the causes of backfire.
6. List two results of a backfire.
7. Name two indications of a flashback.
8. List step by step what should be done in case of a flashback.
9. Discuss the procedure that should be followed if a cut is lost.
10. Demonstrate the ability to:
    a. Make 90° cuts in mild steel.
    b. Cut holes in mild steel.

USE OF THE CUTTING TORCH
UNIT II

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with objective sheet.

  B. Provide students with information and job sheets.

  C. Discuss terminal and specific objectives.

  D. Discuss information sheet.

  E. Demonstrate and discuss procedures outlined in job sheets.

  F. Give test.

II. Student:

  A. Read objectives.

  B. Study information sheets.

  C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

  D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objectives

  B. Information sheet

  C. Job sheets

    1. Job Sheet #1--Make 90° Cuts on Mild Steel

    2. Job Sheet #2--Cut a Hole in Mild Steel

  D. Test

  E. Answers to test

II. References:

A. Althouse, Andrew D., Carl H. Turnquist, and William A. Bowditch. *Modern Welding.* Homewood, Illinois: The Goodheart-Willcox Company, Inc., 1965.

B. *Smith's Short Course for Gas Cutting, Welding, and Brazing.* Minneapolis, Minnesota: Smith Welding Equipment, Division of Tescom Corporation, 1963.

C. Phipps, Lloyd J., J. F. McColby, L. L. Scranton, and G. C. Cook. *Farm Mechanics Text and Handbook.* Danville, Illinois: Interstate Publishers and Printers, 1959.

USE OF THE CUTTING TORCH
UNIT II

INFORMATION SHEET

I. Terms and definitions

A. Oxide--Term usually applied to rust, corrosion, coating, film, or scale

(NOTE: Oxygen combines with the metal causing oxides.)

B. Oxidizing--Combining oxygen with another substance

(NOTE: A metal is oxidized when it is cut.)

C. Cutting--Oxidation of metal with a cutting torch

D. Slag box--Metal container with a layer of water or sand to catch hot slag

E. Drag line--Situation in which the most distant portion of the cutting stream lags behind the stream nearest the cutting tip

F. Kerf--Area where the metal was removed in the form of an oxide during the cutting process

G. Flashback--Fire inside the torch

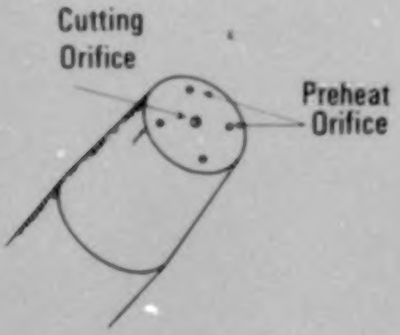
(NOTE: This is a very dangerous condition.)

H. Backfire--Momentary burning back of the flame into the tip

II. Parts of cutting tip

A. Preheat orifice--Preheats metal to kindling point of approximately 1600°F

B. Cutting orifice--Removes oxidized metal



INFORMATION SHEET

III. Purposes of slag box
  A. Catch hot slag
  B. Prevent fire
  C. Protect clothing
  D. Protect welding hoses

IV. Reasons for poor cuts
  A. Improper speed
  B. Inadequate preheat
  C. Insufficient oxygen
  D. Improper pressure

V. Causes of backfire
  A. Insufficient acetylene or oxygen pressure
  B. Loose cutting tip
  C. Dirty tip
  D. Overheating of cutting tip

(NOTE: These things should be carefully checked to prevent backfire.)

VI. Result of a backfire
  A. Flame burns momentarily back into tip
  B. A loud snap or pop results

(NOTE: Flame may go out or continue to burn in a normal manner.)

VII. Indications of flashback
  A. Fire inside torch
  B. Flame disappears
  C. Squealing or hissing noise inside torch
  D. Sparks coming from the torch
  E. Smoke coming from the torch

INFORMATION SHEET

VIII. In case of flashback

A. Close the oxygen preheat valve

B. Close the oxygen torch valve

C. Close acetylene torch valve

D. Release oxygen regulator screw

E. Release acetylene regulator screw

F. Examine acetylene unit

G. Reset regulator pressures

H. Light the torch

(NOTE: If heavy smoke comes out of the torch tip and the torch body becomes hot, the flashback has probably traveled past the mixing chamber into the hose. In this case, shut off the oxygen clyinder valve, the acetylene cylinder valve, and notify your instructor.)

IX. Procedures for restarting a cut

A. Release the oxygen cutting lever

B. Preheat edge (only) where cutting action was stopped

C. Continue cut

USE OF THE CUTTING TORCH
UNIT II

JOB SHEET #1--MAKE 90° CUTS ON MILD STEEL

I. Equipment, tools, and material needed

- A. Cutting outfit with tip assembly
- B. Mild steel plate 1/4" to 1/2" thick, 4" wide or wider, 8" long or longer
- C. Soapstone with a sharp point or edge
- D. Straight edge
- E. Gloves
- F. Safety goggles
- G. Pliers
- H. Coveralls
- I. Flint lighter
- J. Welding table
- K. Slag box
- L. Can of water
- M. Cutting tip #1 (#56 orifice)

II. Procedure

- A. Mark four parallel lines 2" apart on plate to be cut
- B. Adjust oxygen regulator (35 psi)
- C. Adjust acetylene regulator (4 psi)
- D. Place plate to be cut over slag box
- E. Light torch
- F. Adjust to neutral flame
- G. Assume comfortable position
- H. Place hoses behind operator

JOB SHEET #1

I. Maneuver torch with both hands

J. Hold preheat flame with tip of inner cone 1/16" to 1/8" above top of plate at right edge until red spot appears

K. Depress the oxygen cutting lever, raise tip 1/4" to 1/2", and move from right to left across the plate (For left-handed operators, go from left to right.) (Figure A)

L. Hold the tip at right angles to work while cutting with inner cone being 1/4" to 1/2" above work

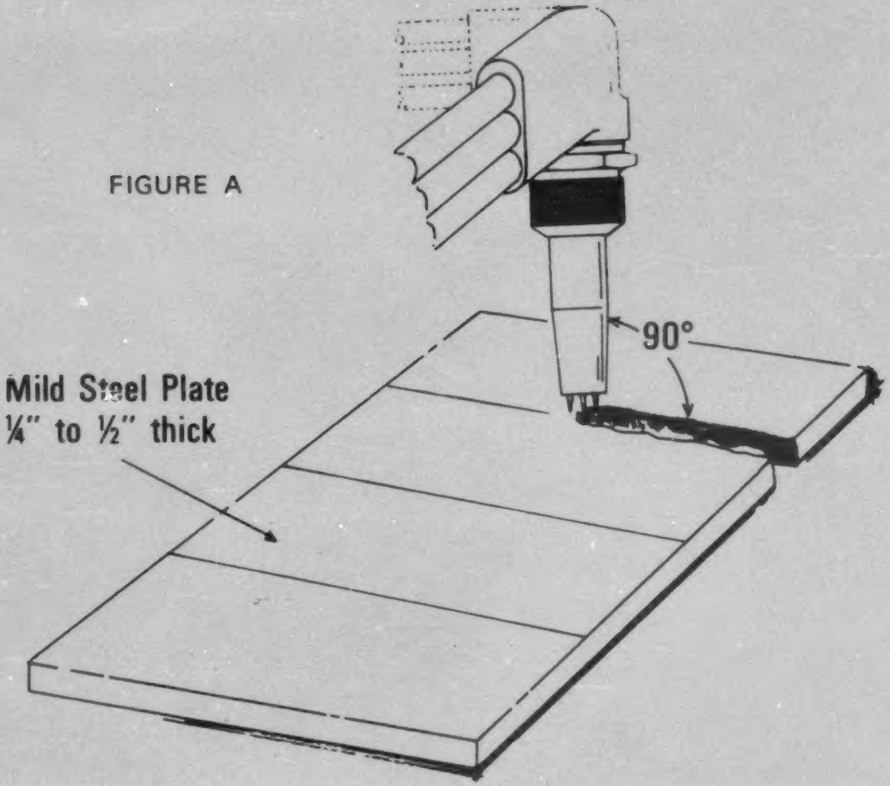
M. Make 90° cuts until you have developed the proper procedure

N. Cool metal by placing in can of water with the aid of pliers

O. Show samples to instructor for approval and grading

III. Diagram of the procedure

FIGURE A



USE OF THE CUTTING TORCH
UNIT II

JOB SHEET #2--CUT HOLES IN MILD STEEL

I. Equipment, tools, and material needed

  A. Cutting outfit with #1 tip (#56 orifice)

  B. Mild steel plates (prepared in Job Sheet #1)

  C. Soapstone with a sharp point or edge

  D. Straight edge

  E. Gloves

  F. Safety goggles

  G. Pliers

  H. Coveralls

  I. Flint lighter

  J. Welding table

  K. Slag box

  L. Can of water

II. Procedure

  A. Draw two circles on metal

    1. 1" in diameter, 1" from edge

    2. 1/2" in diameter, 1" from edge

  B. Adjust oxygen regulator (35 psi)

  C. Adjust acetylene regulator (4 psi)

  D. Place metal to be cut over slag box

  E. Light torch

JOB SHEET #2

F. Adjust to neutral flame

G. Assume comfortable position

H. Place hoses behind operator

I. Maneuver torch with both hands

J. Hold tip of inner cone 1/16" to 1/8" above point to be cut until metal turns bright red (Figure A)

   1. Tilt torch 15° from vertical position (This will allow molten metal to be blown away from operator.)

   2. Depress oxygen cutting lever slowly moving torch backwards (to the operator's right if right-handed) until cut pierces plate

K. Return cutting torch to vertical position

   1. Raise cutting tip until tip of inner cone is from 1/4" to 1/2" above the plate

   2. Make cut (Figure B)

L. Cut just inside soapstone mark until circular cut is completed

   (NOTE: If the mark disappears, use a center punch to mark the outline.)

M. Repeat steps K and L until all holes are cut

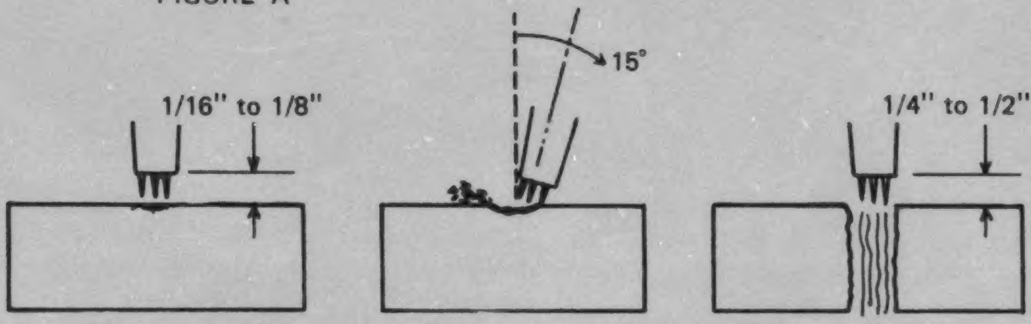
N. Cool metal by placing in can of water with the aid of pliers

O. Show samples to instructor for approval and grading

JOB SHEET #2

III. Diagram of the procedure

FIGURE A


1/16" to 1/8"
15°
1/4" to 1/2"

1.

1. Preheat to bright red

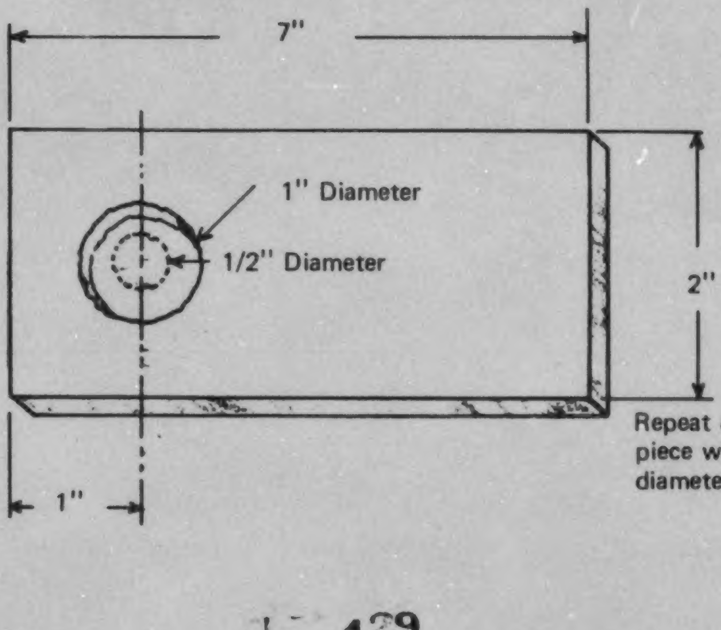
2.

1. Tilt tip 15° from vertical position
2. Depress oxygen cutting lever
3. Return tip to vertical position as the cut starts and raise tip 1/4" to 1/2" above plate

3.

1. Continue cut until circle is complete

FIGURE B


7"
1" Diameter
1/2" Diameter
2"
1"

Repeat cut on second piece with a 1/2" diameter hole

USE OF THE CUTTING TORCH
UNIT II

TEST

1. Match these terms with the correct definition.

_____a. Term usually applied to rust, corrosion, coating, film or scale

_____b. Combining oxygen with another substance

_____c. Oxidation of metal with a cutting torch

_____d. Metal container with a layer of water or sand to catch hot slag

_____e. Situation in which the most distant portion of the cutting stream lags behind the stream nearest the cutting tip

_____f. Area where the metal was removed in the form of an oxide during the cutting process

_____g. Fire inside the torch

_____h. Momentary burning back of the flame into the tip

1. Backfire
2. Cutting
3. Drag line
4. Flashback
5. Kerf
6. Oxide
7. Oxidizing
8. Slag box

2. Name the parts of the cutting tip.

a.

b.

3. Select the purposes of a slag box. Place an "X" before the correct answers.

_____a. Protect welding hoses

_____b. Prevent oxidizing

_____c. Catch hot slag

_____d. Prevent fire

______e. Protect preheat orifice

______f. Protect clothing

4. Select the reasons for poor cuts. Place an "X" in the blank.

______a. Improper pressure

______b. Poor slag box

______c. Inadequate preheat

______d. Insufficient oxygen

______e. Improper speed

5. Select the causes of backfire. Place an "X" in the blank.

______a. Dirty tip

______b. Insufficient kerf

______c. Insufficient acetylene or oxygen pressure

______d. Fire inside the torch

______e. Overheating of cutting tip

______f. Loose cutting tip

6. List two results of a backfire.

a.

b.

7. Name two indications of a flashback.

a.

b.

8. List step by step what should be done in case of a flashback.

a.

b.

c.

d.

e.

f.

g.

h.

9. Discuss the procedure that should be followed if a cut is lost.

10. Demonstrate the ability to:

    a. Make 90° cuts in mild steel

    b. Cut holes in mild steel

    (NOTE: If this has not been accomplished prior to the test, ask the instructor when the above activities should be completed.)

USE OF THE CUTTING TORCH
UNIT II

ANSWERS TO TEST

1. a. 6
   b. 7
   c. 2
   d. 8
   e. 3
   f. 5
   g. 4
   h. 1
2. a. Preheat orifice
   b. Cutting orifice
3. a
   c
   d
   f
4. a
   c
   d
   e
5. a
   c
   e
   f

6. a. Flame burns momentarily back into tip
   b. A loud snap or pop results
7. Any two of these:
   a. Fire inside torch
   b. Flame disappears
   c. Squealing or hissing noise inside torch
   d. Sparks coming from the torch
   e. Smoke coming from the torch
8. a. Close the oxygen preheat valve
   b. Close the oxygen torch valve
   c. Close acetylene torch valve
   d. Release oxygen regulator screw
   e. Release acetylene regulator screw
   f. Examine acetylene unit
   g. Reset regulator pressures
   h. Light the torch
9. Discussion should include these points:
   a. Release the oxygen cutting lever
   b. Preheat edge where cutting action was stopped
   c. Continue cut
10. Performance skills will be evaluated to the satisfaction of the instructor.

OXYACETYLENE FUSION WELDING
UNIT III

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to select the proper size welding tip according to manufacturer's recommendations and choose the correct filler rod for a welding job. He should be able to carry a puddle with or without a filler rod. This knowledge will be evidence through demonstration and by scoring eighty-five percent on a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match eight terms and definitions associated with oxyacetylene fusion welding.
2. Select from a list five factors that determine the quality of an oxyacetylene fusion weld
3. Name five properties of a good weld.
4. List two factors that determine the selection of tip size in oxyacetylene welding.
5. Name two factors that determine the type of filler rod to use in oxyacetylene welding.
6. Name the purpose of the filler rod.
7. Demonstrate the ability to:
    a. Construct a corner weld without a filler rod.
    b. Lay beads on a flat plate with and without a filler rod.
    c. Construct a flat butt weld, using a filler rod.

OXYACETYLENE FUSION WELDING
UNIT II.

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Discuss terminal and specific objectives.

   D. Discuss information sheet.

   E. Demonstrate and discuss procedures outlined in the job sheets.

   F. Give test.

II. Student:

   A. Read objectives.

   B. Study information sheet.

   C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objectives

   B. Information sheet

   C. Job sheets

      1. Job Sheet #1--Make a Corner Weld Without Filler Rod

      2. Job Sheet #2--Lay Beads on Flat Plate Without Filler Rod

      3. Job Sheet #3--Lay Beads on Flat Plate With Filler Rod

      4. Job Sheet #4--Weld Butt Joints With Filler Rod

   D. Test

   E. Answers to test

II. References:

A. *Smith's Instructor's Manual for a Basic Course in Oxyacetylene Brazing, Cutting, and Welding (Form 424).* Minneapolis, Minnesota: Smith Welding Equipment, Division of Tescom Corporation, 1967.

B. *Smith's Short Course for Gas Cutting, Welding, and Brazing.* Minneapolis, Minnesota: Smith Welding Equipment, Division of Tescom Corporation, 1963.

C. Phipps, Lloyd J., J. F. McColby, L. L. Sranton, and G. C. Cook. *Farm Mechanics Text and Handbook.* Danville, Illinois: Interstate Publishers and Printers, 1959.

D. *The Oxyacetylene Handbook: A Manual on Oxyacetylene Welding and Cutting Procedures.* New York: Union Carbide Corporation, Linde Division, 1960.

E. Althouse, Andrew D., Carl H. Turnquist, and William A Bowditch. *Modern Welding.* Homewood, Illinois: The Goodheart-Willcox Company, Inc., 1965.

OXYACETYLENE FUSION WELDING
UNIT III

INFORMATION SHEET

I. Terms and definitions

  A. Fusion welding--The joining of pieces of metal by heating the adjoining edges to the fusion or melting point and allowing them to flow or run together and then cool

  B. Penetration--The distance from the original surface of the base metal to that point at which fusion ceases

  C. Base metal--The metal to be welded

  D. Alloy--A mixture with metallic properties composed of two or more elements of which at least one is a metal

  E. Inner cone--The inner white part of the neutral flame

  F. Backfire--A momentary burning back of the flame into the tip, flame goes out with a loud snap or pop

  G. Flashback--A fire inside the torch indicated by a hissing or squealing sound

  H. Tack weld--A small weld used for temporarily holding material in place

II. Factors determining fusion weld quality

  A. Proper flame adjustment

  B. Angle of tip

  C. Distance from work

  D. Speed of travel

  E. Movement of tip

III. Properties of a good weld

  A. Consistent width

  B. Straightness

  C. Slightly crowned

  D. Fused into base metal

  E. Clean appearance

INFORMATION SHEET

IV. Factors determining tip size selection

  A. Metal thickness

  B. Size of welding rod

V. Factors determining rod selection

  A. Rod with similar properties as base metal

  B. Thickness of metal

  (NOTE: A general rule is to use a rod with a diameter equal to the thickness of the base metal.)

VI. Purpose of filler rod--To add strength to weld or joint

OXYACETYLENE FUSION WELDING
UNIT III

JOB SHEET #1–MAKE A CORNER WELD WITHOUT FILLER ROD

I. Tools and equipment

- A. Oxyacetylene welding unit
- B. Welding tip (according to manufacturer's recommendations)
- C. Gloves
- D. Goggles
- E. Pliers
- F. Wire brush
- G. Flint lighter
- H. Fire brick

II. Materials--Two pieces of mild steel strips, 16 gauge 1 1/4" by 6"

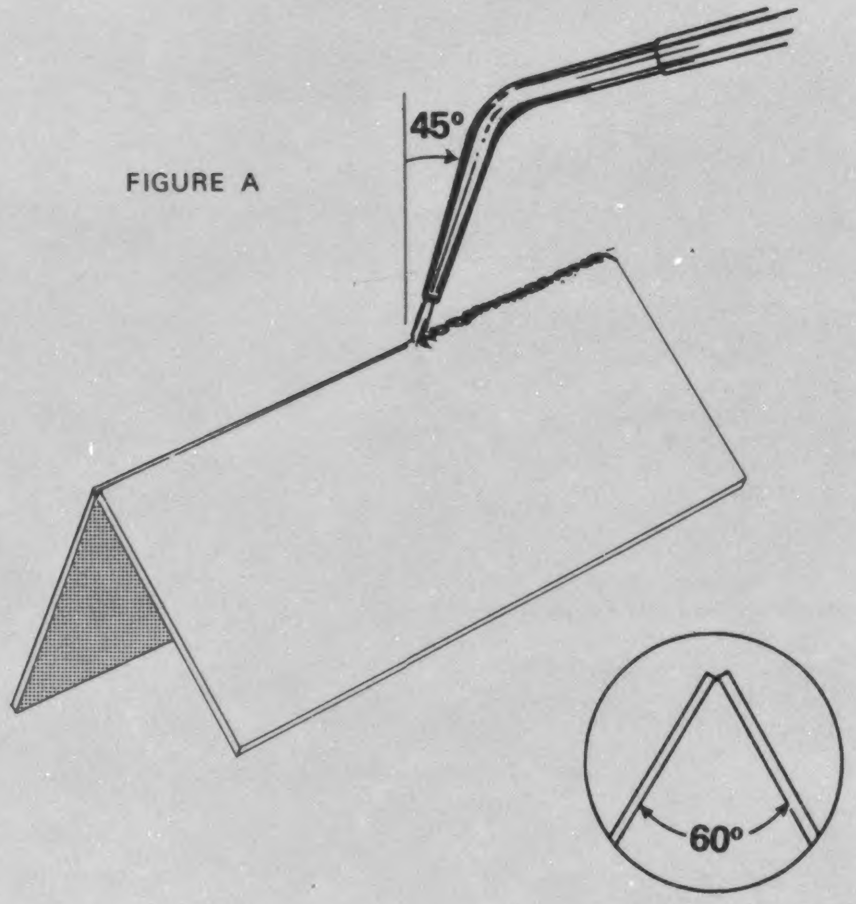
III. Procedure

- A. Prepare metal for welding
- B. Place metal in welding position (See Figure A.)
- C. Turn on oxyacetylene unit
- D. Set working pressure (according to manufacturer's recommendations)
- E. Light torch and adjust to an oxidizing flame
- F. Tack weld metal in position
- G. Place inner cone about 1/16" to 1/8" from plate
- H. Do not begin travel until you have established a molten puddle (a bright shiny spot)
- I. Begin welding at right end
- J. Hold tip vertically at 45° angle from direction of travel
- K. Slowly weave flame from side to side across the weld or in small circles
- L. Repeat process until instructor gives permission to go on to next job

JOB SHEET #1

IV. Diagram of the procedure

FIGURE A



OXYACETYLENE FUSION WELDING
UNIT III

JOB SHEET #2--LAY BEADS ON FLAT PLATE WITHOUT FILLER ROD

I. Tools and equipment

- A. Oxyacetylene welding unit
- B. Welding tip (according to manufacturer's recommendations)
- C. Gloves
- D. Goggles
- E. Pliers
- F. Wire brush
- G. Flint lighter
- H. Fire brick

II. Material--One piece of mild steel strip, 1/8" thick by 4" by 6"

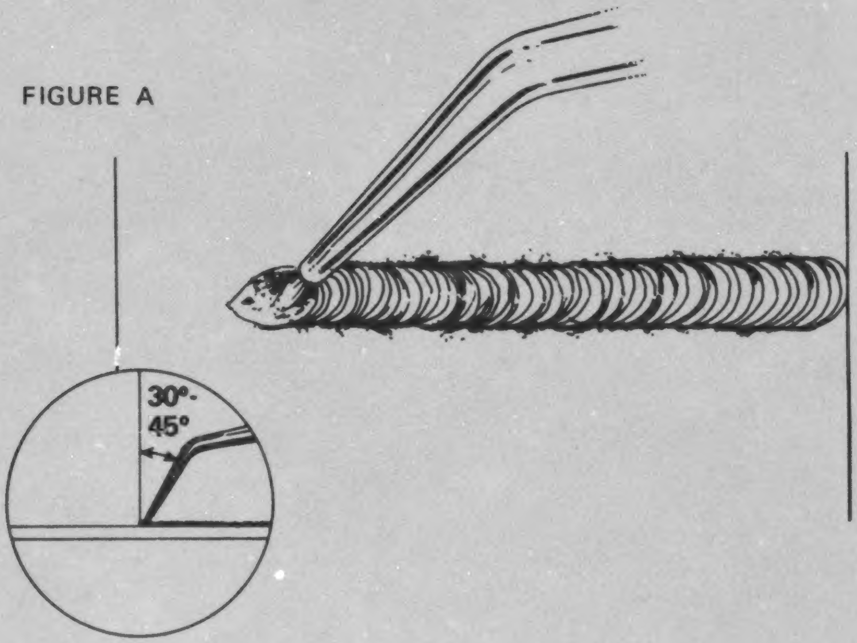
III. Procedure

- A. Prepare metal for welding
- B. Place metal in welding position
- C. Turn on oxyacetylene unit
- D. Set working pressure (according to manufacturer's recommendations)
- E. Light torch and adjust to a neutral flame
- F. Place inner cone about 1/16" to 1/8" from plate
- G. Do not begin travel until you have established a molten puddle
- H. Hold torch 30° to 45° from center in direction of travel
- I. Slowly move the torch forward allowing the metal to melt
- J. Repeat process until instructor gives permission to go on to next job

JOB SHEET #2

IV. Diagram of the procedure

FIGURE A



OXYACETYLENE FUSION WELDING
UNIT III

JOB SHEET #3--LAY BEADS ON FLAT PLATE WITH FILLER ROD

I. Tools and equipment

- A. Oxyacetylene welding unit
- B. Welding tip (according to manufacturer's recommendations)
- C. Gloves
- D. Goggles
- E. Pliers
- F. Wire brush
- G. Flint lighter
- H. Fire brick

II. Material

- A. One piece of mild steel strip, 16 gauge 1 1/4" by 6"
- B. Filler rod mild steel (according to manufacturer's recommendations)

III. Procedure

- A. Prepare metal for welding
- B. Place metal in welding position
- C. Turn on oxyacetylene unit
- D. Set working pressure (according to manufacturer's recommendations)
- E. Light torch and adjust to a neutral flame
- F. Hold torch 30° to 45° from center
- G. Place inner cone about 1/16" to 1/8" from surface of puddle
- H. Do not begin travel until you have established a molten puddle
- I. Add filler rod to puddle in front of torch
- J. Move puddle forward with torch and allow puddle to form in base metal
- K. Add rod and withdraw rod as you move puddle forward

JOB SHEET #3

L. Keep puddle the same size and shape the entire length of the bead

M. Show bead to instructor when completed

IV. Diagram of the procedure

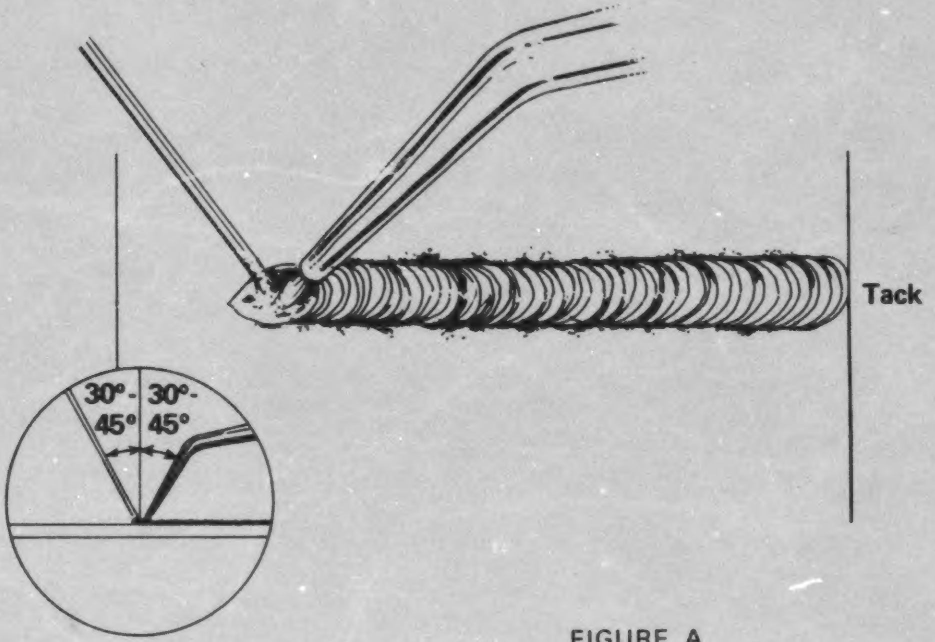


FIGURE A

OXYACETYLENE FUSION WELDING
UNIT III

JOB SHEET #4--WELD BUTT JOINTS WITH FILLER ROD

I. Tools and equipment

  A. Oxyacetylene welding unit

  B. Welding tip (according to manufacturer's recommendations)

  C. Gloves

  D. Goggles

  E. Pliers

  F. Wire brush

  G. Flint lighter

  H. Fire brick

II. Materials

  A. Two pieces of mild steel strips, 16 gauge 1 1/4" by 6"

  B. Filler rod mild steel (according to manufacturer's recommendations)

III. Procedure

  A. Prepare metal for welding

  B. Place metal in welding position

  C. Turn on oxyacetylene unit

  D. Set working pressure (according to manufacturer's recommendations)

  E. Light torch and adjust to a neutral flame

  F. Tack weld metal together

  G. Hold torch 30° to 45° from center

  H. Do not begin travel until you have established a molten puddle

  I. Place inner cone about 1/16" to 1/8" from surface of puddle

  J. Add filler rod to puddle in front of torch

  K. Move puddle forward with torch and allow puddle to form in base metal

JOB SHEET #4

L. Add rod and withdraw rod as you move puddle forward

M. Keep puddle the same size and shape the entire length of the bead

IV. Diagram of the procedure

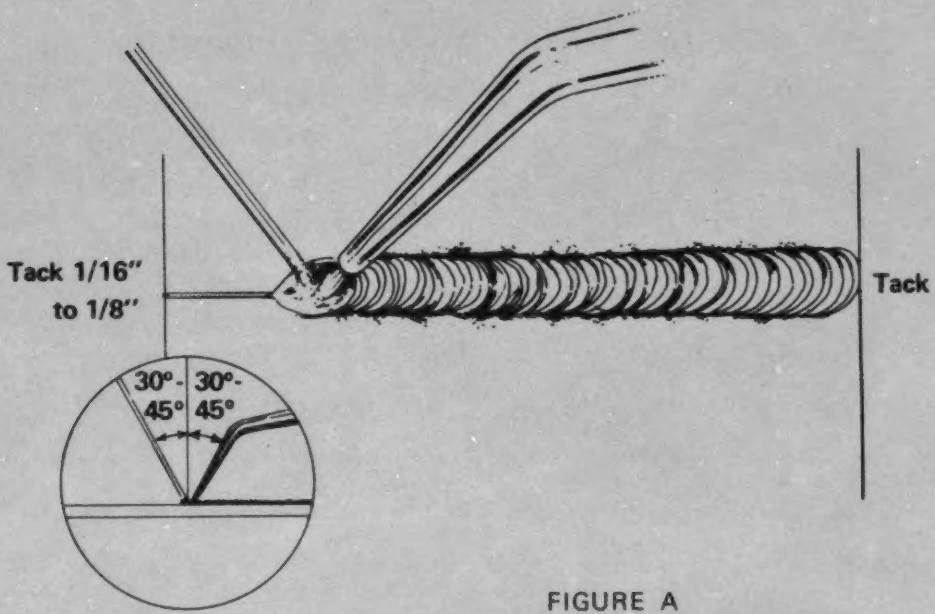

Tack 1/16"
to 1/8"
Tack
30°-
45°
30°-
45°

FIGURE A

OXYACETYLENE FUSION WELDING
UNIT III

TEST

1. Match each of these terms with the correct definition.

_____a. The joining of pieces of metal by heating the adjoining edges to the fusion or melting point and allowing them to flow or run together and then cool

_____b. The distance from the original surface of the base metal to that point at which fusion ceases

_____c. The metal to be welded

_____d. A mixture with metallic properties composed of two or more elements of which at least one is a metal

_____e. The inner white part of the neutral flame

_____f. A momentary burning back of the flame into the tip, flame goes out with a loud snap or pop

_____g. A fire inside the torch indicated by a hissing or squealing sound

_____h. A small weld used for temporarily holding material in place

1. Alloy
2. Backfire
3. Base metal
4. Flashback
5. Fusion welding
6. Inner cone
7. Penetration
8. Tack weld

2. Select the factors that determine the quality of an oxyacetylene fusion weld. Place an "X" before the correct answers.

_____a. Angle of tip

_____b. Mixture of alloy

_____c. Movement of tip

_____d. Tack weld

______e. Proper flame adjustment

______f. Distance from work

______g. Speed of travel

3. Name five properties of a good weld.

   a.

   b.

   c.

   d.

   e.

4. What are the two factors that determine the selection of tip size in oxyacetylene welding?

   a.

   b.

5. Name two factors that determine the type of filler rod to use in oxyacetylene welding.

   a.

   b.

6. What is the purpose of the filler rod?

7. Demonstrate the ability to:

   a. Construct a corner weld without a filler rod.

   b. Lay beads on a flat plate with and without a filler rod.

   c. Construct a flat butt weld using a filler rod.

   (NOTE: If this has not been accomplished prior to the test, ask the instructor when the above activities should be completed.)

OXYACETYLENE FUSION WELDING
UNIT III

ANSWERS TO TEST

1. a. 5
   - b. 7
   - c. 3
   - d. 1
   - e. 6
   - f. 2
   - g. 4
   - h. 8
2. a
   - c
   - e
   - f
   - g
3. a. Consistent width
   - b. Straightness
   - c. Slightly crowned
   - d. Fused into base metal
   - e. Clean appearance
4. a. Metal thickness
   - b. Size of welding rod
5. a. Rod with similar properties as base metal
   - b. Thickness of metal
6. To add strength to weld or joint
7. Performance skills will be evaluated to the satisfaction of the instructor.

OXYACETYLENE BRAZING
UNIT IV

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to distinguish between braze and fusion welding and be able to list advantages and disadvantages of brazing. He should be able to demonstrate the procedures for applying flux to a filler rod and construct a butt weld using the brazing process. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match five terms and definitions associated with brazing.
2. Discuss the difference between braze and fusion welding.
3. Name three advantages of brazing.
4. Write two disadvantages of brazing.
5. Name two reasons for having a clean metal surface before brazing.
6. Name one way of removing oxides from a clean metal surface.
7. Name five purposes of flux.
8. Demonstrate the ability to construct a brazing butt weld joint.

OXYACETYLENE BRAZING
UNIT IV

SUGGESTED ACTIVITIES

I. Instructor:

- A. Provide students with objective sheet.
- B. Provide students with information and job sheets.
- D. Discuss terminal and specific objectives.
- E. Discuss information sheet.
- F. Demonstrate the correct procedure of braze welding.
- G. Give test.

II. Student:

- A. Read objectives.
- B. Study information sheet.
- C. Demonstrate the proper procedure of braze welding.
- D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objectives
- B. Information sheet
- C. Job Sheet #1--Braze a Butt Joint
- D. Test
- E. Answers to test

II. References:

- A. *The Oxy-Acetylene Handbook: A Manual on Oxy-Acetylene Welding and Cutting Procedures.* New York: Union Carbide Corporation, Linde Division, 1960.
- B. Aithouse, Andrew D., Carl H. Turnquist, and William A. Bowditch. *Modern Welding.* Homewood, Illinois: The Goodheart-Willcox Company, Inc., 1965.
- C. Giachino, J. W., William Weeks, and Elmer Brune. *Welding Skills and Practices.* Chicago, Illinois: American Technical Society, 1967.

OXYACETYLENE BRAZING
UNIT IV

INFORMATION SHEET

I. Terms and definitions

   A. Brazing--The uniting of two pieces of metal together to form one piece by the use of a bronze rod and flux

   B. Malleability--A property of metals which allows them to be bent or permanently distorted without rupture

   C. Ductile--A term describing metal which is capable of being drawn or stretched out

   D. Tinning operation--The melting of a small amount of bronze rod onto the surface and allowing it to spread along the entire seam

   E. Flux--A chemical used to clean metals during the welding process

II. Braze and fusion welding

   A. Brazing--The joining of metals using bronze rod and flux

   B. Fusion--The melting of metals until the molten portions unite with each other

III. Advantages of brazing

   A. Main characteristics of base metal not destroyed

   B. Less gas consumed

   C. Can be used on thin metals

   D. Used on malleable casting

   E. May be used in joining different kinds of metals

IV. Disadvantages of brazing

   A. Cannot be used on metal where stress is a factor

   B. Expensive to use

V. Reasons for clean metal surface

   A. Bronze will stick easier

   B. Allows bronze to flow smoothly and evenly over entire weld area

VI. Removal of metal oxides--By use of flux

INFORMATION SHEET

VII. Purposes of flux

A. Chemically cleans the base metal

B. Prevents oxidation of the filler rod

C. Removes oxides from metal

D. Increases flow of filler rod

E. Brings filler metal into immediate contact with the metals being joined

F. Permits filler metal to penetrate the pores of the base metal

OXYACETYLENE BRAZING
UNIT IV

JOB SHEET #1--BRAZE A BUTT JOINT

I. Tools and equipment

- A. Oxyacetylene welding unit
- B. Gloves
- C. Safety glasses
- D. Goggles
- E. Welding tip (according to manufacturer's recommendations)
- F. Wire brush
- G. Flint lighter
- H. Fire brick

II. Materials

- A. Two pieces of mild steel strips, 1/8" thick, 1 1/4" by 6"
- B. Bronze filler rod (use according to manufacturer's recommendations)
- C. Welding flux

III. Procedures

- A. Prepare metal for brazing--clean
- B. Place metal in brazing position 1/16" to 1/8" apart
- C. Turn on oxyacetylene unit
- D. Adjust proper working pressure of oxygen and acetylene (use manufacturer's recommendations)
- E. Place metal on fire brick

  (NOTE: Do not lay metal flat on brick; arrange metal so a small space will be between the base metal and the fire brick.)
- F. Light and adjust torch to a neutral flame
- G. Preheat the end of the brazing rod and dip in the flux or use fluxed rod
- H. Tack metal in place
- I. Heat the surface of the weld area slightly

JOB SHEET #1

J. Hold torch 30° to 45° from the center

K. Melt a small amount of bronze rod onto the surface and allow it to spread along the entire seam when a cherry-red color occurs

L. When the base metal is tinned sufficiently, start depositing the proper size bead

M. Watch for base metal color

(NOTE: When metal is not hot enough, the bronze will form into drops; when metal is too hot, bronze tends to boil.)

N. Complete the weld and practice doing others

IV. Diagram of the procedure

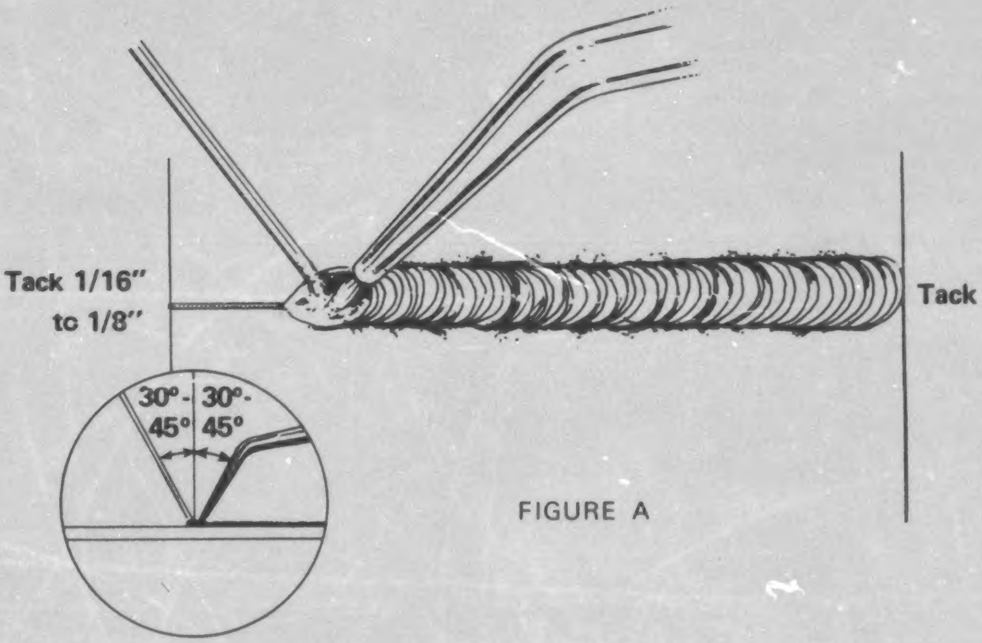


FIGURE A

OXYACETYLENE BRAZING
UNIT IV

TEST

1. Match the following terms to the correct definition.

______a. The uniting of two pieces of metal together to form one piece by the use of a bronze rod and flux

______b. A property of metals which allows them to be bent or permanently distorted without rupture

______c. A term describing metal which is capable of being drawn or stretched out

______d. The melting of a small amount of bronze rod onto the surface and allowing it to spread along the entire seam

______e. A chemical used to clean metals during the welding process

1. Brazing
2. Ductile
3. Flux
4. Malleability
5. Tinning operation

2. In what way is brazing different from fusion welding?

3. Name three advantages of brazing.

a.

b.

c.

4. Write two disadvantages of brazing.

a.

b.

5. Name two reasons for having a clean metal surface before brazing.

   a.

   b.

6. How would you remove oxides from a clean metal surface?

7. Name five purposes of a flux.

   a.

   b.

   c.

   d.

   e.

8. Demonstrate the ability to construct a brazing butt weld joint.

   (NOTE: If this has not been accomplished prior to the test, ask the instructor when the above activities should be completed.)

OXYACETYLENE BRAZING
UNIT IV

ANSWERS TO TEST

1. a. 1
   b. 4
   c. 2
   d. 5
   e. 3
2. The answer should include these points:
   a. Brazing is the joining of metals using bronze rod and flux
   b. Fusion is the melting of metals until the molten portions unite with each other
3. Any three of the following:
   a. Main characteristics of base metal not destroyed
   b. Less gas consumed
   c. Can be used on thin metals
   d. Used on malleable castings
   e. May be used in joining different kinds of metals
4. a. Cannot be used on metal where stress is a factor
   b. Expensive to use
5. a Bronze will stick easier
   b. Allows bronze to flow smoothly and evenly over entire weld area
6. By use of flux
7. Any five of the following:
   a. Chemically cleans the base metal
   b. Prevents oxidation of the filler rod
   c. Removes oxides from metal
   d. Increases flow of filler rod

e. Brings filler metal into immediate contact with the metals being joined

f. Permits filler metal to penetrate the pores of the base metal

8. Performance skills will be evaluated to the satisfaction of the instructor.

ARC WELDING
UNIT I

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to identify welding equipment, types of welds, welding joints, and welding positions. He should be able to discuss methods and purposes of coating electrodes, reasons for poor welds, and safety precautions to use in arc welding. This knowledge will be evidenced by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match eight terms and definitions associated with arc welding.
2. Identify the common equipment needed in arc welding.
3. List two types of arc welders.
4. Select from a list the effects of raising or lowering the arc welding current.
5. List four types of electrodes.
6. List the two common sizes of electrodes.
7. Discuss the methods and purposes of coating electrodes.
8. Name the two methods of striking the arc.
9. Identify the three types of welds.
10. Identify five types of weld joints.
11. Identify five welding positions.
12. Discuss four reasons for poor welds.
13. Discuss safety precautions to use in arc welding.

ARC WELDING
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

- A. Provide students with objective sheet.
- B. Provide students with information sheet.
- C. Make transparencies.
- D. Discuss terminal and specific objectives.
- E. Discuss information sheet.
- F. Give test.

II. Student:

- A. Read objectives.
- B. Study information sheet.
- C. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objectives
- B. Information sheet
- C. Transparency masters
    1. TM 1--Arc Welding Equipment
    2. TM 2--E6011 Mild Steel Electrode
    3. TM 3--Types of Welds
    4. TM 4--Types of Welding Joints
    5. TM 5--Welding Positions
- D. Test
- E. Answers to test

II. References:

A. Jones, M. M. *Shopwork on the Farm.* New York: McGraw-Hill Book Company, 1955.

B. Phipps, Lloyd J., H. F. McColly, L. L. Scranton, and G. C. Cook. *Farm Mechanics Text and Handbook.* Danville, Illinois: Interstate Publishers and Printers, 1959.

C. Kugler, Harold L. *Arc Welding Lessons for School and Farm Shop.* Cleveland, Ohio: The James F. Lincoln Arc Welding Foundation.

D. Hollenbury, Q. A. *How to Teach Arc Welding in Farm Mechanics.* Cleveland, Ohio: The James F. Lincoln Arc Welding Foundation, 1958.

E. *Hobart Welding School Workbook.* Troy, Ohio: Hobart Brothers' Technical Center.

ARC WELDING
UNIT I

INFORMATION SHEET

I. Terms and definitions

- A. Arc--Flow of electric current across a narrow gap
- B. Base metal--Metal to be welded
- C. Bead weld--Made by one pass of the electrode
- D. Bevel--Type of edge preparation
- E. Butt joint--Weld between two metal parts in the same plane
- F. Crater--Depression at the end of a weld
- G. Electrodes--Metal rods which conduct a current from the electrode holder to the base metal
- H. Welding--Fusion of metals

II. Arc welding equipment (Transparency 1)

- A. Welder
- B. Electrode holder with leads
- C. Ground clamp with leads
- D. Shield or helmet
- E. Gloves
- F. Chipping hammer
- G. Safety goggles
- H. Wire brush
- I. Electrodes

III. Types of arc welders

- A. AC (alternating current) welder--Current alternating direction 120 times per second
- B. DC (direct current) welder--Current flowing in the same direction

INFORMATION SHEET

IV. Effects of adjustments on the arc welder current

  A. Raising amps--Produces more heat

  B. Lowering amps--Produces less heat

V. Types of electrodes (Transparency 2)

  A. Mild steel

  B. High carbon steel

  C. Alloys

  D. Hard surfacing

VI. Common electrode sizes--Determined by diameter of bare end of electrode

  A. 1/8"

  B. 5/32"

  (NOTE: Electrodes range in size from 1/16" to 3/8".)

VII. Welding with coated electrodes--Called shielded arc welding

  A. Methods of coating electrodes

    1. Wrapping

    2. Dipping (Electrodes are dipped into a liquid flux solution.)

    3. Extruding (This is the most common method.)

  B. Purposes of electrode coating

    1. Stabilizes arc

    2. Shields molten puddle from air

    3. Floats impurities out of puddle

    4. Forms slag and slows cooling

    5. Increases speed and improves quality of welding

INFORMATION SHEET

VIII. Methods of striking the arc

- A. Scratching (similar to striking a match)
  1. Move electrode at an angle across work
  2. Strike electrode to metal
  3. Pull electrode forward with sweeping motion
  4. Raise electrode slightly
- B. Tapping
  1. Hold electrode perpendicular to work
  2. Lower electrode and tap lightly on work

IX. Types of welds (Transparency 3)

- A. Bead
- B. Fillet
- C. Groove

X. Types of weld joints (Transparency 4)

- A. Butt
- B. Corner
- C. Tee
- D. Lap
- E. Edge

XI. Welding positions (Transparency 5)

- A. Flat--Running a bead on a flat surface
- B. Horizontal--Running a horizontal bead on a vertical surface
- C. Vertical down--Running a vertical bead from top to bottom on a vertical surface

INFORMATION SHEET

D. Vertical up--Running a vertical bead from bottom to top on a vertical surface

E. Overhead--Running a bead overhead on a horizontal surface

XII. Reasons for poor welds

A. Machine adjustment too hot or too cool

B. Electrode size too large or too small

C. Improper movement of electrode

D. Improper angle of holding the electrode

E. Improper base metal preparation

F. Arc length too short or too long

XIII. Safety precautions to be used in arc welding

A. Never look at arc with the naked eye

B. Use a head or face shield that is in good condition

C. Wear suitable clothing to protect all parts of body

1. Long-sleeved shirt
2. Leather gloves
3. Collar buttoned
4. Cuffs turned down
5. High-topped shoes or boots

D. Do not strike an arc or weld until sure those in the vicinity have protective equipment or will look in the other direction (Yell "COVER" before striking an arc.)

E. Do not weld around combustible or flammable materials

F. Do not pick up hot metal

G. Do not weld in confined places without ventilation

INFORMATION SHEET

H. Always shut off main switch or disconnect plug when checking over a welder

I. Do not leave electrode holder on welding table or in contact with grounded metal surface

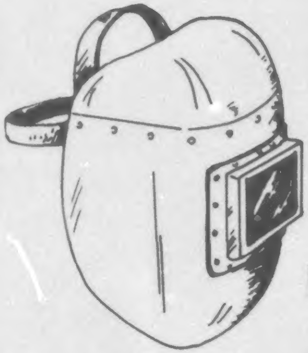
J. Do not use worn or frayed cables

K. Stand on dry footing when welding

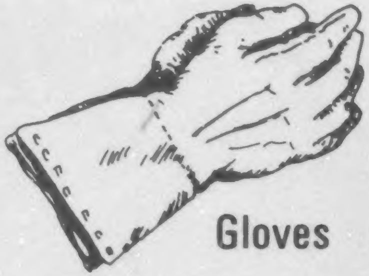
L. Keep area around welder clean

M. Keep tools and metal in their proper locations

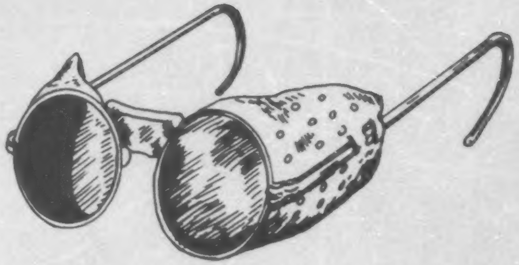
Arc Welding Equipment



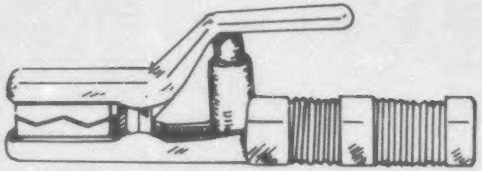
Helmet



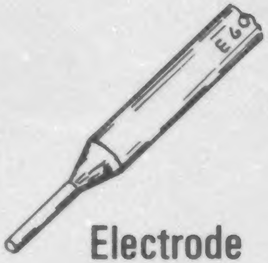
Gloves



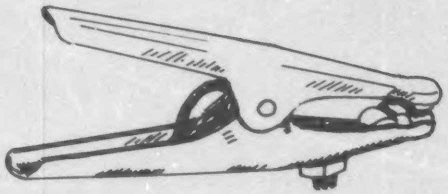
Safety Goggles



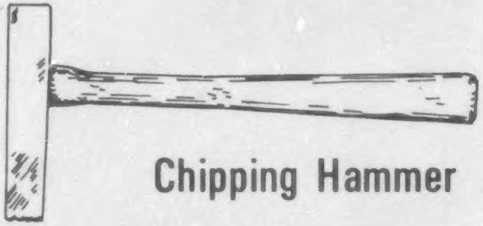
Electrode Holder



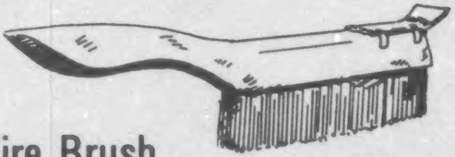
Electrode



Ground Clamp



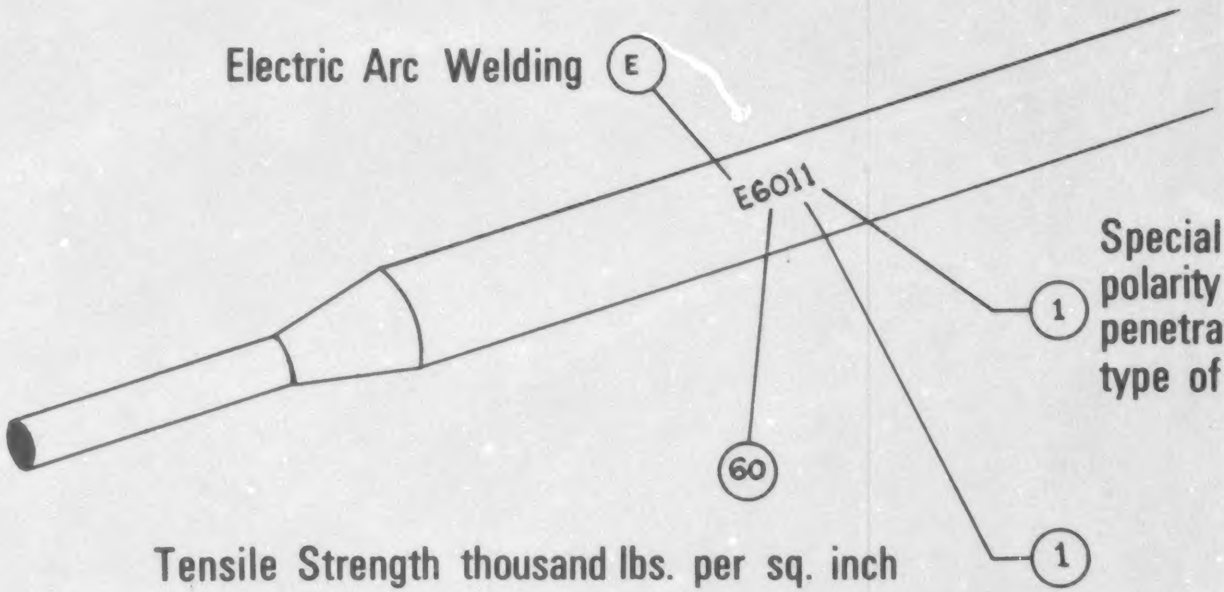
Chipping Hammer



Wire Brush

E6011 Mild Steel Electrode

STANDARDIZED AWS CLASSIFICATION



Electric Arc Welding

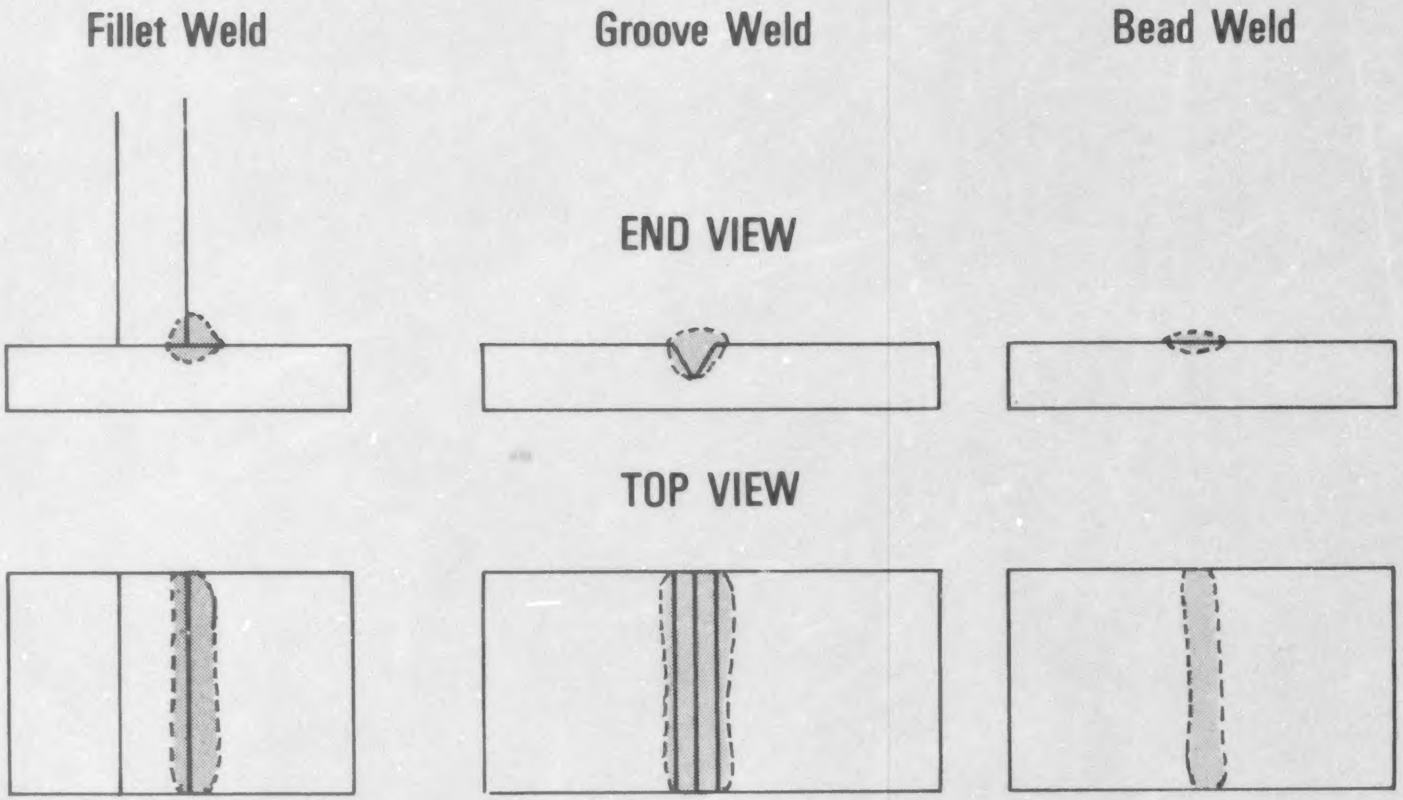
Special char.
polarity
penetration
type of welder

Tensile Strength thousand lbs. per sq. inch

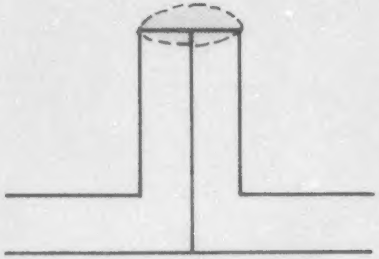
Welding Position

1. all positions
2. flat and horizontal
3. flat

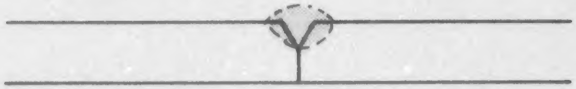
Types of Welds


Fillet Weld
Groove Weld
Bead Weld
END VIEW
TOP VIEW

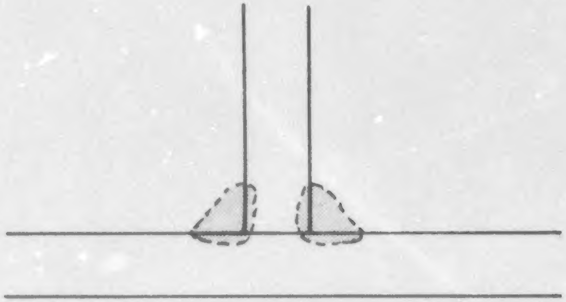
Types of Welding Joints



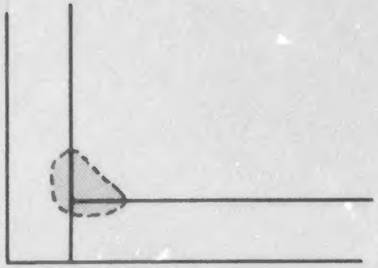
Edge Joint



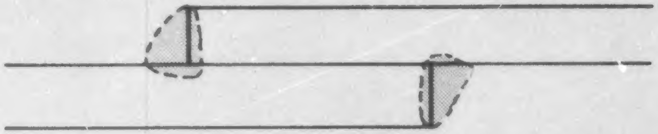
Butt Joint



Tee Joint

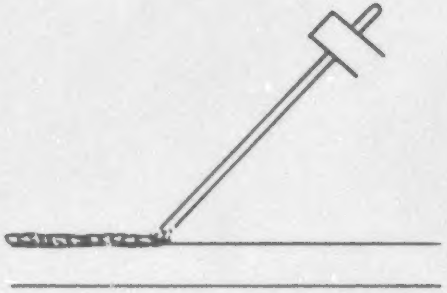


Corner Joint

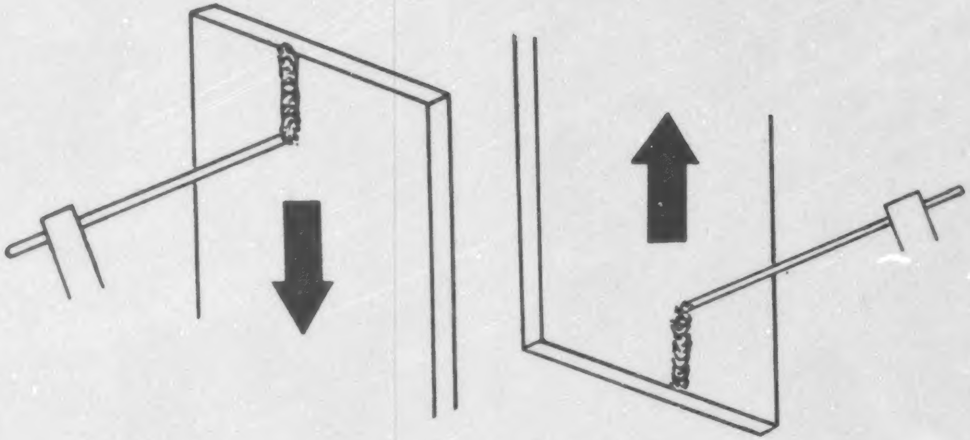


Lap Joint

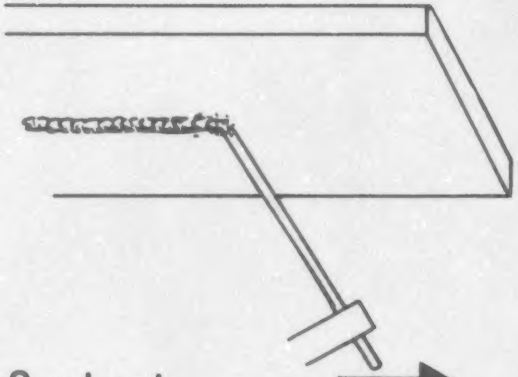
Welding Positions



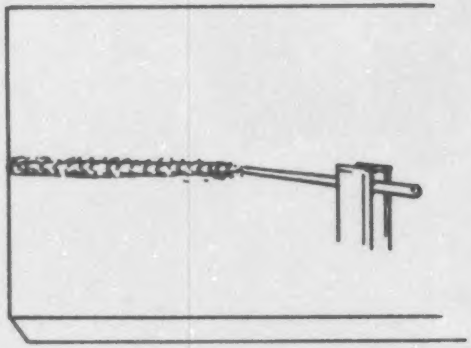
Flat



Vertical



Overhead



Horizontal

ARC WELDING
UNIT I

TEST

1. Match these terms with the correct definition.

_____a. Made by one pass of the electrode

_____b. Metal rods which conduct a current from the electrode holder to the base metal

_____c. Metal to be welded

_____d. Fusion of metals

_____e. Weld between two metal parts in the same plane

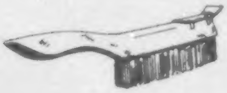
_____f. Flow of electric current across a narrow gap

_____g. Type of edge preparation

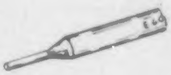
_____h. Depression at the end of a weld

1. Arc
2. Base metal
3. Bead weld
4. Bevel
5. Butt joint
6. Crater
7. Electrodes
8. Welding

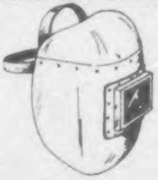
2. Identify these pieces of arc welding equipment.



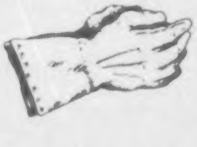
a. ________________________



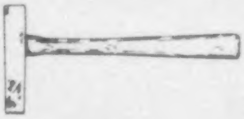
b. ________________________



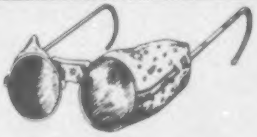
c. ________________________



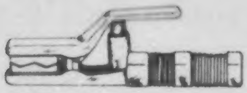
d. ________________________



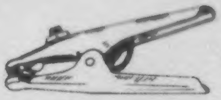
e. ________________________



f. ________________________



g. ______________________



h. ______________________

3. List two types of arc welders.

   a.

   b.

4. Select from the list the effects of these adjustments on the arc welder current.

_____a. Raising amps	1. Produces more heat
_____b. Lowering amps	2. Reduces the wattage
	3. Produces less heat
	4. Increases the wattage

5. List four types of electrodes.

   a.

   b.

   c.

   d.

6. List the two common sizes of electrodes.

   a.

   b.

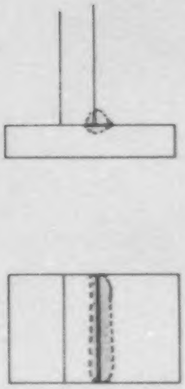
7. Discuss the methods and purposes of coating electrodes.

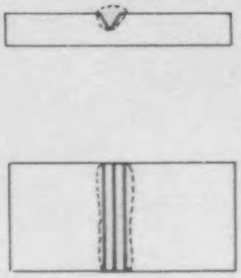
8. Name the two methods of striking the arc.

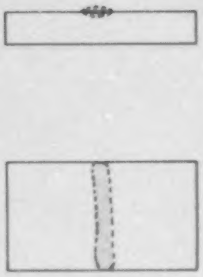
   a.

   b.

9. Identify these types of welds.

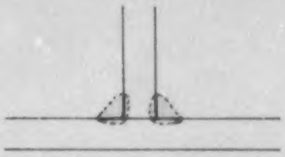


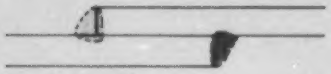




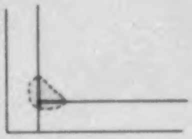
a.____________________ b.____________________ c.____________________

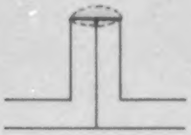
10. Identify these types of weld joints.



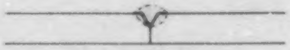


a. ______________________________ b. ______________________________



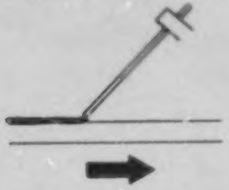


c. ______________________________ d. ______________________________

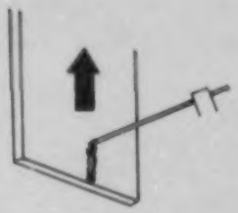


e. ______________________________

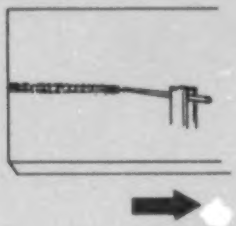
11. Identify these welding positions.



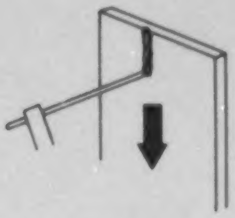
a. ______________________



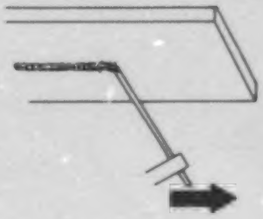
b. ______________________



c. ______________________



d. ______________________



e. ______________________

12. Discuss four reasons for poor welds.

13. Discuss safety precautions to use in arc welding.

ARC WELDING
UNIT I

ANSWERS TO TEST

1. a. 3
   - b. 7
   - c. 2
   - d. 8
   - e. 5
   - f. 1
   - g. 4
   - h. 6
2. a. Wire brush
   - b. Electrode
   - c. Helmet
   - d. Gloves
   - e. Chipping hammer
   - f. Goggles
   - g. Electrode holder
   - h. Ground clamp
3. a. AC (alternating current) welder
   - b. DC (direct current) welder
4. a. 1
   - b. 3
5. a. Mild steel
   - b. High carbon steel
   - c. Alloys
   - d. Hard surfacing

6. a. 1/8"
   - b. 5/32"
7. Discussion should include:
   - a. Methods of coating electrodes
     - 1) Wrapping
     - 2) Dipping (Electrodes are dipped into a liquid flux solution.)
     - 3) Extruding (This is the most common method.)
   - b. Purposes of electrode coating
     - 1) Stabilizes arc
     - 2) Shields molten puddle from air
     - 3) Floats impurities out of puddle
     - 4) Forms slag and slows cooling
     - 5) Increases speed and improves quality of welding
8. a. Scratching
   - b. Tapping
9. a. Fillet weld
   - b. Groove weld
   - c. Bead weld
10. a. Tee joint
    - b. Lap joint
    - c. Corner joint
    - d. Edge joint
    - e. Butt joint
11. a. Flat
    - b. Vertical

- c. Horizontal
- d. Vertical down
- e. Overhead

12. Discussion should include:
    - a. Machine adjustment too hot or too cool
    - b. Electrode size too large or too small
    - c. Improper movement of electrode
    - d. Improper angle of holding the electrode
    - e. Improper base metal preparation
    - f. Arc length too short or too long

13. Discussion should include:
    - a. Never look at arc with the naked eye
    - b. Use a head or face shield that is in good condition
    - c. Wear suitable clothing to protect all parts of body
        - 1) Long-sleeved shirt
        - 2) Leather gloves
        - 3) Collar buttoned
        - 4) Cuffs turned down
        - 5) High-topped shoes or boots
    - d. Do not strike an arc or weld until sure those in the vicinity have protective equipment or will look in the other direction
    - e. Do not weld around combustible or flammable materials
    - f. Do not pick up hot metal
    - g. Do not weld in confined places without ventilation
    - h. Always shut off main switch or disconnect plug when checking over a welder
    - i. Do not leave electrode holder on welding table or in contact with grounded metal surface

j. Do not use worn or frayed cables

k. Stand on dry footing when welding

l. Keep area around welder clean

m. Keep tools and metal in their proper locations

POSITION WELDING
UNIT II

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to deposit beads in the flat, vertical, and horizontal positions using an E-6011 and/or E-6010 electrode. He should be able to construct a V-butt weld in flat position and run a continuous bead without breaking the arc. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match ten terms used in position welding with their definitions.
2. List four factors that determine proper current adjustment.
3. List three reasons for removing slag from a bead.
4. Name three reasons for fusing one bead in with another.
5. List the four variables that determine weld quality.
6. Identify beads formed properly and improperly by telling what caused each one.
7. Demonstrate the ability to:
    a. Start, stop, and restart a bead.
    b. Construct a complete pad on 3/8" plate, 6" by 6", using E-6011 and/or E-6010 electrode paying special attention to proper fusion of lapping beads in the following positions:
        1) Flat
        2) Horizontal
        3) Vertical (up)
    c. Make a V-butt weld in flat position.
    d. Run a continuous bead.

POSITION WELDING
UNIT II

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Make transparency.

   D. Discuss terminal and specific objectives.

   E. Discuss information sheet.

   F. Demonstrate and discuss procedures outlined in the job sheets.

   G. Give test.

II. Student:

   A. Read objectives.

   B. Study information sheet.

   C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objectives

   B. Information sheet

   C. Transparency master: TM 1--Properly and Improperly Formed Beads

   D. Job sheets

      1. Job Sheet #1--Start, Stop, and Restart a Bead

      2. Job Sheet #2--Make a Pad in the Flat Position

      3. Job Sheet #3--Make a Pad in the Horizontal Position

4. Job Sheet #4--Make a Pad in the Vertical (Up) Position

5. Job Sheet #5--Make a V-butt Weld

6. Job Sheet #6--Run a Continuous Bead

E. Test

F. Answers to test

II. References:

A. Althouse, Andrew D., Carl H. Turnquist, and William A. Bowditch. *Modern Welding.* Homewood, Illinois: The Goodheart-Willcox Company, Inc., 1965.

B. Giachino, Joseph William, William Weeks, Elmer Brune. *Welding Skills and Practices.* Third Edition, Chicago, Illinois: American Technical Society, 1967.

C. *The Welding Encyclopedia.* The Welding Engineer Publishing Company, Division of the McGraw-Hill Publishing Company, Inc.

POSITION WELDING
UNIT II

INFORMATION SHEET

I. Terms and definitions

- A. Pads--The metal plates which have beads running parallel to each other in such a way that the beads are united with one another to form a solid mass
- B. Horizontal position--The running of a horizontal bead on a vertical surface
- C. Vertical position--The beads deposited in a vertical position on a horizontal surface
- D. Face--The exposed surface of a fusion weld
- E. Root--The bottom surface of a fusion weld
- F. Penetration- The distance from the original surface of the base metal to that point at which fusion ceases
- G. Undercutting--The portion of the crater left unfilled due to excessive current and the improper movement of the electrode occuring at the edge of the bead
- H. Porosity--A condition which is caused by the oxidation of a gas pocket trapped in a weld as it solidifies
- I. Crater--A depression in the face of a weld caused by arc force
- J. Fusion--The melting of metals until the molten portions unite with each other

II. Factors determining proper current adjustment

- A. Length of welding cables
- B. Thickness of base metal
- C. Diameter of electrode
- D. Welding technique used by operator
- E. Efficiency of welding machine and polarity
- F. Type of joint
- G. Welding positions

INFORMATION SHEET

III. Reasons for removing slag

   A. Permits better fusion of beads

   B. Prevents gas pockets from forming in bead

   C. Improves appearance of bead

IV. Reasons for fusing one bead in with another

   A. Increases strength of weld

   B. Improves appearance of bead

   C. Improves penetration

V. Variables that determine weld quality

   A. Amperage

   B. Length of arc

   C. Speed of travel

   D. Position of electrode

VI. Causes of properly and improperly formed beads (Transparency 1)

   A. Current, voltage, and speed normal

   B. Current too low

   C. Current too high

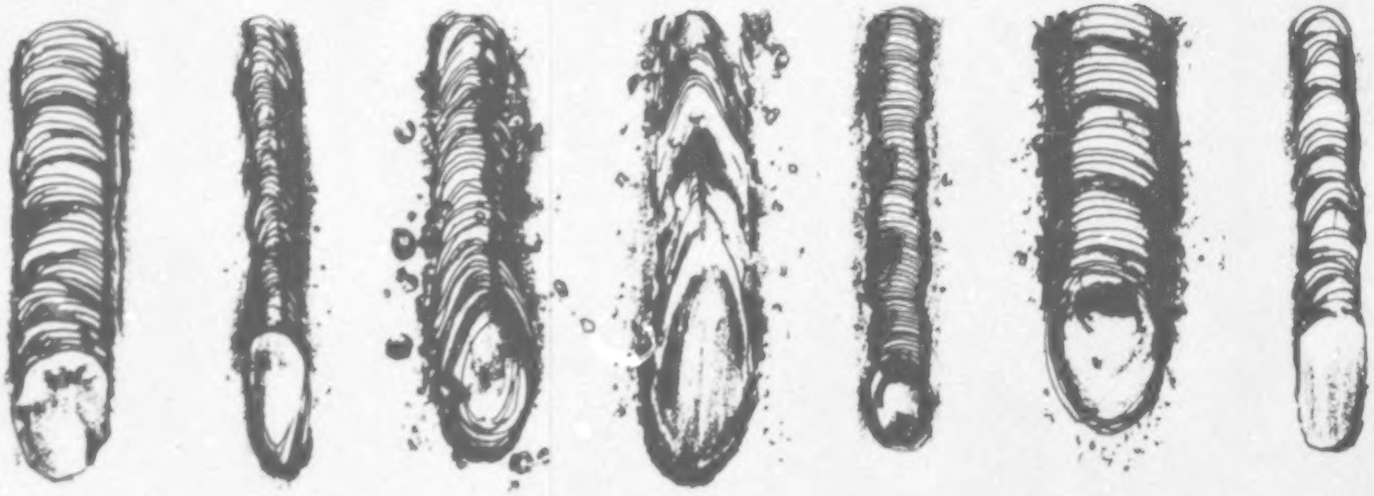
   D. Voltage too low

   E. Voltage too high

   F. Speed too slow

   G. Speed too fast

Properly and Improperly Formed Beads


Current, voltage, and speed normal
Current low
Current high
Voltage low
Voltage high
Speed slow
Speed fast

POSITION WELDING
UNIT II

JOB SHEET #1–START, STOP, AND RESTART A BEAD

I. Tools and equipment

   A. Welder, electrode holder, and ground clamp

   B. Gloves, helmet, and safety glasses

   C. Chipping hammer

   D. Wire brush

   E. Pliers or vise grips

II. Materials

   A. Mild steel metal 3/8" thick, 6" x 6"

   B. E-6011 or E-6010 electrode

III. Procedure

   A. Start

      1. Hold electrode perpendicular to work

      2. Slant electrode 10° to 15° in direction of travel

      3. Lower electrode and strike lightly on edge of plate

      4. Raise electrode as arc strikes

      5. Lower electrode to shorten arc

      6. As desired crater develops, move electrode out slowly with normal movement

      7. Move electrode to build up desired height and width of bead

   B. Stop

      1. As weld length is reduced, return electrode perpendicular to work

      2. Lower electrode to shorten arc

      3. Move electrode to build up crater and remove impurities

      4. Raise electrode quickly to break arc

      5. Development of desired bead

JOB SHEET #1

C. Restart

1. Start arc about 1/2" to 1" in front of crater
2. Use long arc movement back to within 1/16" of the crater crown
3. Bring electrode down rapidly
4. Continue welding maintaining correct width of bead

POSITION WELDING
UNIT II

JOB SHEET #2--MAKE A PAD IN THE FLAT POSITION

I. Tools and equipment

  A. Welder, electrode holder, and ground clamp

  B. Gloves, helmet, and safety glasses

  C. Chipping hammer

  D. Wire brush

  E. Pliers or vise grips

II. Materials

  A. Mild steel metal 3/8" thick, 6" by 6"

  B. E-6011 or E-6010 electrode

III. Procedure

  A. Prepare metal for welding

  B. Place metal in proper welding position

  C. Strike arc and begin welding

  D. Hold electrode at a 15° to 30° angle in direction of travel

  E. After completion of one bead, chip and brush clean

  F. Check bead and surface for

    1. Surface appearance

    2. Pinholes, crater holes, slag holes, or improper starts and stops

    3. Determine if current or amps need to be changed

  G. Continue running beads overlapping at least the first one-third of the previous bead

  H. Clean each pass before running next bead

  I. Fuse each pass with base metal and prior bead

  J. Overlapping beads should produce a smooth surface without "valleys" between passes

JOB SHEET #2

K. Continue welding until pad is filled with beads

L. Clean metal and turn in to the instructor for grading

IV. Diagram of the procedure

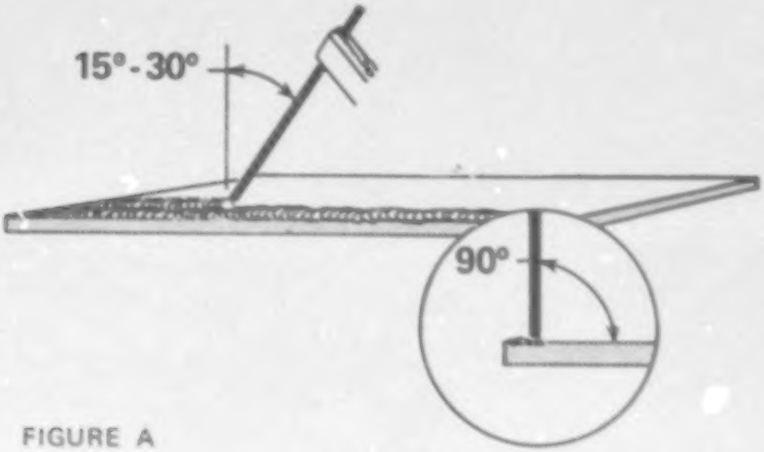

15°-30°
90°
Front or Back View

FIGURE A

POSITION WELDING
UNIT II

JOB SHEET #3--MAKE A PAD IN THE HORIZONTAL POSITION

I. Tools and equipment

   A. Welder, electrode holder, and ground clamp

   B. Gloves, helmet, and safety glasses

   C. Chipping hammer

   D. Wire brush

   E. Pliers or vise grips

II. Materials

   A. Mild steel metal 3/8" thick, 6" by 6"

   B. E-6011 or E-6010 electrode

III. Procedure

   A. Prepare metal for welding

   B. Place metal in proper welding position

   C. Hold electrode 20° away from deposited bead in direction of travel

   D. Point electrode upward 5° to 10°

   E. Strike arc and begin welding

   F. Move electrode to prevent sagging and causing an overlap and undercutting

   G. Run a straight bead along the bottom side

   H. After laying one bead, chip and brush clean

   I. Check bead and surface

      1. Surface appearance

      2. Pinholes, crater holes, slag holes, or improper starts and stops

      3. Determine by appearance if current and amps need to be changed

   J. Continue running beads overlapping at least the first one-third of the previous bead

JOB SHEET #3

K. Clean each pass before overlapping

L. Fuse each pass with base metal and other bead

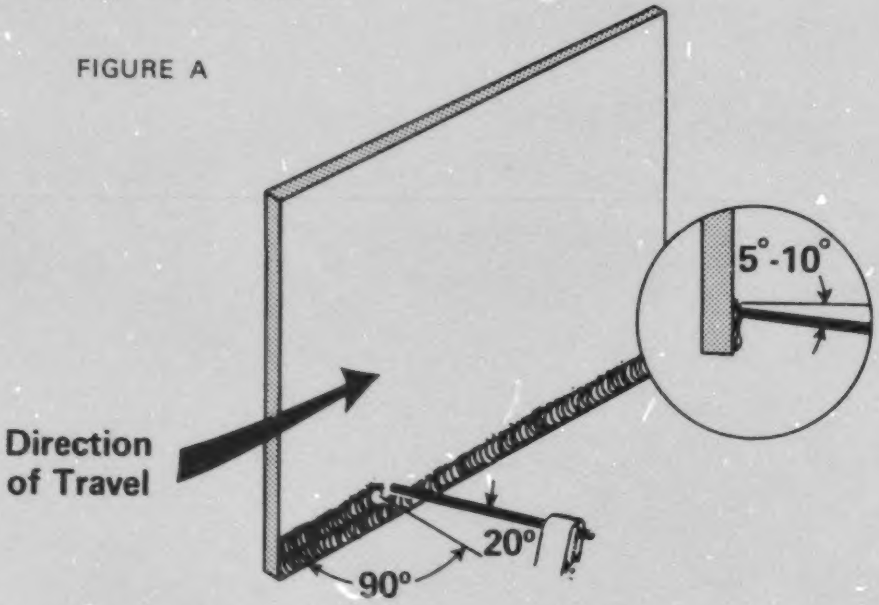
M. Overlapping beads should produce a smooth surface without "valleys" between passes

N. Continue welding until pad is filled with beads

O. Clean metal and turn in to the instructor for grading

III. Diagram of the procedure

FIGURE A



POSITION WELDING
UNIT II

JOB SHEET #4--MAKE A PAD IN THE VERTICAL (UP) POSITION

I. Tools and equipment

   A. Welder, electrode holder, and ground clamp

   B. Gloves, helment, and safety glasses

   C. Chipping hammer

   D. Wire brush

   E. Pliers or vise grips

II. Materials

   A. Mild steel metal 3/8" thick, 6" by 6"

   B. E-6011 or E-6010 electrode

III. Procedure

   A. Prepare metal for welding

   B. Place metal in proper welding position

   C. Hold electrode 10° to 15° with the horizontal surface

   D. Strike arc and begin welding

   E. Move tip of the electrode upward in the direction of the weld

      (NOTE: Some type of "pattern" should be used such as circular or triangular movement.)

   F. Run a straight bead

   G. After laying one bead, chip and brush clean

   H. Check bead and surface

      1. Surface appearance

      2. Pinholes, crater holes, slag holes, or improper starts and stops

      3. Determine by appearance if current and amps need to be changed

   I. Continue running beads overlapping at least the first one-third of the previous bead

   J. Clean each pass before overlapping

JOB SHEET #4

K. Fuse each pass with base metal and other bead

POSITION WELDING
UNIT II

JOB SHEET #5--MAKE A V-BUTT WELD

I. Tools and equipment

  A. Welder, electrode holder, and ground clamp

  B. Gloves, helmet, and safety glasses

  C. Chipping hammer

  D. Grinder

  E. Wire brush

  F. Pliers

  G. Steel tape

II. Materials

  A. Two pieces of steel plate 5" long by 3" wide by 3/8" thick

  B. E-6011 or E-6010 electrode

III. Procedure

  A. Prepare metal for welding

    1. Bevel edges of metal 60° (See Figure A.)

    2. Place two pieces together parallel to each other

    3. Metal should be spaced 3/32" to 1/8"

    4. Tack weld pieces together at both ends

    5. Place metal in proper position

  B. Weld pieces together using a single pass

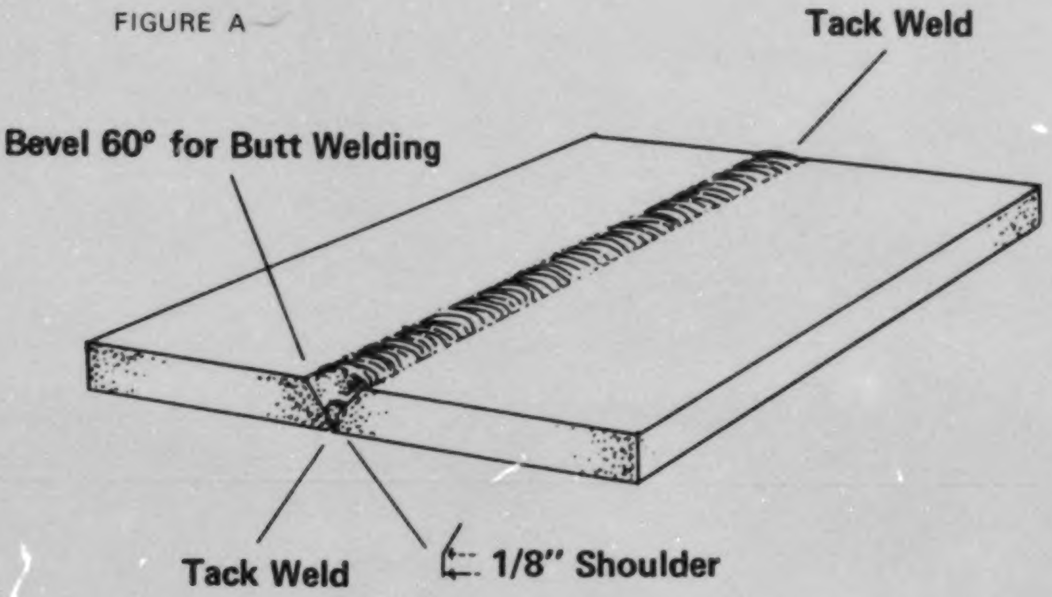
  C. Chip slag and brush clean

  D. Turn in to instructor for grading

JOB SHEET #5

IV. Diagram of the procedure

FIGURE A


Tack Weld
Bevel 60° for Butt Welding
Tack Weld
1/8" Shoulder

POSITION WELDING
UNIT II

JOB SHEET #6--RUN A CONTINUOUS BEAD

I. Tools and equipment

- A. Welder, electrode holder, and ground clamp
- B. Gloves, helmet, and safety glasses
- C. Chipping hammer
- D. Wire brush
- E. Pliers

II. Materials

- A. Mild steel plate 4" long by 4" wide by 1/8" to 3/8" thick
- B. Black pipe nipple 4" long by 3/4" to 2" in diameter

III. Procedure

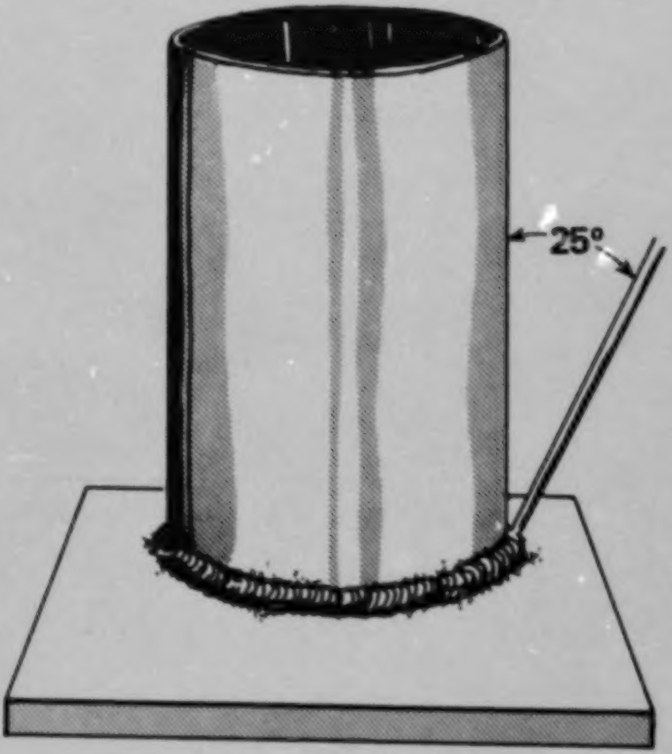
- A. Place nipple near center of plate
- B. Place metal in proper welding position
- C. Start weld at position shown in diagram
- D. Hold electrode 25° from nipple

  (NOTE: This is to keep excessive heat off the nipple.)
- E. Strike arc and continue welding without breaking arc
- F. Chip slag and brush clean
- G. Turn in to instructor for grading

JOB SHEET #6

IV. Diagram of the procedure

FIGURE A



POSITION WELDING
UNIT II

TEST

1. Match the following terms with the correct definition.

_____a. Bottom surface of a fusion weld

_____b. Distance from the original surface of the base metal to that point at which fusion ceases

_____c. Running a horizontal bead on a vertical surface

_____d. Exposed surface of a fusion weld

_____e. Metal plates which have beads running parallel to each other in such a way that the beads are united with one another to form a solid mass

_____f. Portion of the crater left unfilled due to excessive current and the improper movement of the electrode occuring at the edge of the bead

_____g. Beads deposited in a vertical position on a horizontal surface

_____h. Melting metals until the molten portions unite with each other

_____i. Depression in the face of a weld caused by arc force

_____j. Condition caused by the oxidation of a gas pocket trapped in a weld as it solidifies

1. Pads
2. Horizontal position
3. Face
4. Root
5. Vertical position
6. Penetration
7. Undercutting
8. Porosity
9. Crater
10. Fusion

2. List four factors which determine proper current adjustments.

   a.

   b.

   c.

   d.

3. List three reasons for removing slag from a bead.

   a.

   b.

   c.

4. Name three reasons for fusing one bead in with another.

   a.

   b.

   c.

5. What are the four variables that determine weld quality?

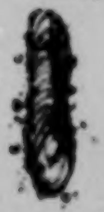
   a.

   b.

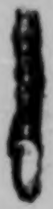
   c.

   d.

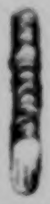
6. Identify the following examples of properly and improperly formed beads by telling what caused each one.



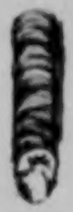
a. ____________



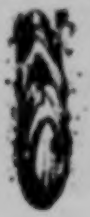
b. ____________



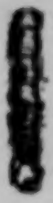
c. ____________



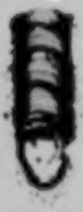
d. ____________



e. ____________



f. ____________



g. ____________

7. Demonstrate the ability to:

   a. Start, stop, and restart a bead.

   b. Construct a pad in the flat, horizontal, and vertical (up) positions.

   c. Make a V-butt weld.

   d. Run a continuous bead.

   (NOTE: If this has not been accomplished prior to the test, ask the instructor when the above activity should be completed.)

POSITION WELDING
UNIT II

ANSWERS TO TEST

1. a. 4
   b. 6
   c. 2
   d. 3
   e. 1
   f. 7
   g. 5
   h. 10
   i. 9
   j. 8

2. Any four of the following:
   a. Length of welding cables
   b. Thickness of base metal
   c. Diameter of electrode
   d. Welding technique used by operator
   e. Efficiency of welding machine and polarity
   f. Type of joint
   g. Welding positions

3. a. Permits better fusion of beads
   b. Prevents gas pockets from forming in bead
   c. Improves appearance of bead

4. a. Increases strength of weld
   b. Improves appearance of bead
   c. Improves penetration

5. a. Amperage
   b. Length of arc
   c. Speed of travel
   d. Position of electrode

6. a. Current too high
   b. Current too low
   c. Speed too fast
   d. Current, voltage, and speed normal
   e. Voltage too low
   f. Voltage too high
   g. Speed too slow

7. Performance skills will be evaluated to the satisfaction of the instructor.

ENGINE OPERATION
UNIT I

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to match terms and definitions associated with small engines. He should be able to identify operating positions, valve parts, and valve failures and describe the operation and use of small engines. He should be able to disassemble and reassemble a small gasoline engine. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms and definitions associated with small gasoline engine repair.
2. Match the names with the parts of a small engine when given a drawing of the engine.
3. Name five machines that are powered by a small gasoline engine.
4. Identify the three basic operating positions on small gasoline engines.
5. Name and describe the four principal events in the operation of a four-cycle engine.
6. Distinguish between a two-stroke cycle engine and a four-stroke cycle engine
7. Name three advantages of an air-cooled engine.
8. Name the simple rule for testing compression.
9. Match the names with the parts of a valve when given a drawing illustrating the parts.
10. Identify three types of valve failure when given a drawing showing each type.
11. Complete an engine inspection chart.
12. Demonstrate the ability to:
    a. Disassemble a small gasoline engine.
    b. Reassemble a small gasoline engine.

ENGINE OPERATION
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with objective sheet.

  B. Provide students with information, job, and assignment sheets.

  C. Make transparencies.

  D. Discuss terminal and specific objectives.

  E. Discuss information and assignment sheets.

  F. Demonstrate and discuss procedures outlined in the job sheets.

  G. Give test.

II. Students:

  A. Read objectives.

  B. Study information sheets.

  C. Complete assignment sheet and turn in to instructor.

  D. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

  E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objectives

  B. Information sheet

  C. Transparency masters

    1. TM 1--Small Engine Parts

    2. TM 2--Engine Operating Positions

    3. TM 3--Events of a Four-Cycle Engine

    4. TM 4--Events of a Two-Cycle Engine

5. TM 5--Valve Parts

6. TM 6--Types of Valve Failures

D. Assignment Sheet #1--Engine Inspection Chart

E. Job sheets

1. Job Sheet #1--Disassemble a Small Gasoline Engine

2. Job Sheet #2--Reassemble a Small Gasoline Engine

F. Test

G. Answers to test

II. References:

A. *Small Engines Care, Operation, Maintenance, and Repair,* Volume I. Athens, Georgia: American Association for Agricultural Engineering and Vocational Agriculture, 1968.

B. *Briggs and Stratton Repair Instructions III.* Milwaukee, Wisconsin: Briggs and Stratton Corporation.

C. *General Theories of Operation.* Milwaukee, Wisconsin: Briggs and Stratton Corporation.

D. *Small Gasoline Engines Student Handbook.* University Park, Pennsylvania: Pennsylvania State University, College of Agriculture, Department of Agricultural Education, 1969.

ENGINE OPERATION
UNIT I

INFORMATION SHEET

I. Terms and definitions

   A. B.D.C. (Bottom dead center)--Lowest position the piston can go

   B. Combustion--The process of burning fuel and air

   C. Compression--The pressing or squeezing together of the fuel and air in an engine

   D. Gasket--Anything used as a packing, such as a non-metallic substance, placed between two metal surfaces to act as a seal

   E. Governor--A device consisting of a control which is used to regulate engine speed

   F. Score--A scratch, ridge, or groove marring a finished surface

   G. Spark gap--The space between the electrodes of a spark plug through which the spark jumps

   H. Stroke--The total distance traveled by the piston in either direction

   I. T.D.C. (Top dead center)--Highest position the piston can go

II. Small engine parts (Transparency 1)

   A. Air cleaner--The device which filters the air to be mixed with the fuel in the engine

   B. Cam--The device which rotates to raise and lower the valves

   C. Camshaft--The shaft containing lobes or cams to operate the engine

   D. Carburetor--A device for automatically mixing fuel in the proper proportion with air to produce a combustible gas

   E. Combustion chamber--The volume of the cylinder above the piston with the piston on top dead center

   F. Condenser--A device for temporarily collecting and storing a surge of electrical current for later discharge

   G. Connecting rod--A rod that connects the piston to the crankshaft

INFORMATION SHEET

H. Crankcase--The housing in which the crankshaft and many other parts of the engine operate

I. Crankshaft--The main shaft of the engine which, in conjunction with the connecting rods, changes the reciprocating motion of the pistons into rotary motion

J. Cylinder--A round hole having some depth bored to receive a piston also sometimes referred to as *bore* or *barrel*

K. Cylinder block--The largest single part of an engine; the basis or main mass of metal in which the cylinders are bored or placed

L. Cylinder head--A detachable portion of an engine fastened securely to the cylinder block which contains all or a portion of the combustion chamber

M. Exhaust valve--A valve which permits the remains of the burned fuel to leave the chamber

N. Fuel tank--The device which contains the fuel to be burned in the engine

O. Flywheel--A heavy wheel which maintains the speed of the engine while it is running

P. Intake valve--A valve which permits a fluid or gas to enter the chamber and seals the exit

Q. Oil filler plug--The device which closes the opening where the crankcase is filled with oil

R. Piston--A cylindrical part closed at one end which is connected to the crankshaft by the connecting rod

S. Piston head--The part of the piston above the rings

T. Piston ring--An expanding ring placed in the grooves of the piston to provide a seal to prevent the passage of fluid or gas past the piston

U. Spark plug--A device inserted into the combustion chamber of an engine containing an insulated control electrode for conducting current

V. Valve--A device for opening and closing the openings that admit the air and gas mixture into the cylinder

III. Machines powered by small engine

A. Motorcycles

B. Chain saws

INFORMATION SHEET

- C. Mowers
- D. Outboard motors
- E. Pumps
- F. Posthole diggers
- G. Elevators

IV. Operating postions (Transparency 2)

- A. Vertical
- B. Horizontal
- C. Multi-position

V. Events of a 4-cycle engine (Transparency 3)

- A. Intake stroke
    1. Exhaust valve is closed
    2. Intake valve is open
    3. The piston moves downward and the air-fuel mixture is drawn into the cylinder
- B. Compression
    1. Intake valve closes
    2. Piston moves upward
    3. The air-fuel mixture is compressed
- C. Power
    1. Spark occurs igniting the mixture
    2. Forces of expanding gases push the piston down
- D. Exhaust
    1. Exhaust valve opens
    2. Upward movement of piston forces the burned gases out of the cylinder

INFORMATION SHEET

3. Exhaust valve closes

4. Cycle is repeated

VI. Engines

A. 4-cycle

1. Two revolutions of crankshaft per firing

2. Lubricated from crankcase oil in the sump

B. 2-cycle (Transparency 4)

1. One revolution of crankshaft per firing

2. Lubricated from oil mixed with the gasoline

VII. Advantages of air-cooled engines

A. No need for complicated cooling system

B. Lighter in weight and occupies less space

C. Easy to repair

VIII. Testing compression--Give the flywheel a quick spin and if it rebounds on the compression stroke, the compression is at least good enough to start the engine

IX. Parts of a valve (Transparency 5)

A. Head

B. Margin

C. Seat

D. Face

E. Stem

F. Valve guide

X. Valve failures (Transparency 6)

A. Burned

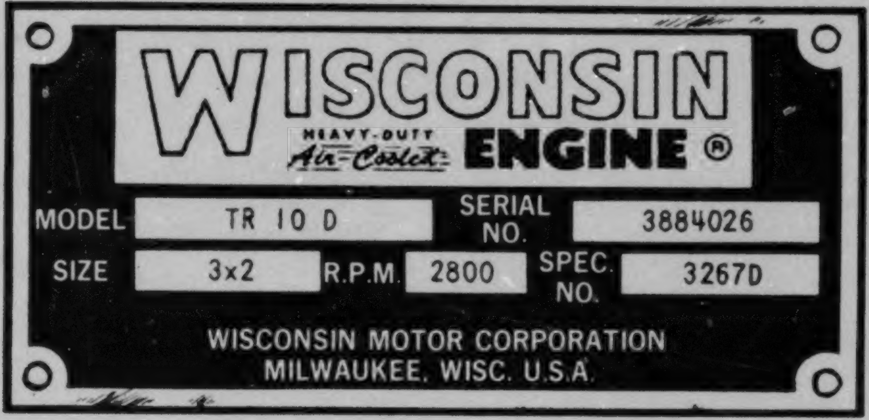
B. Necked

C. Dished

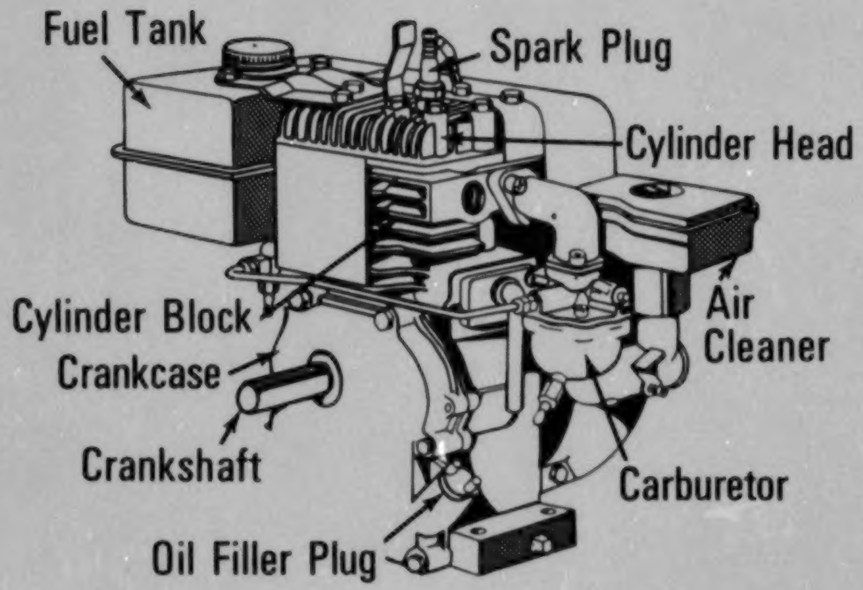
INFORMATION SHEET

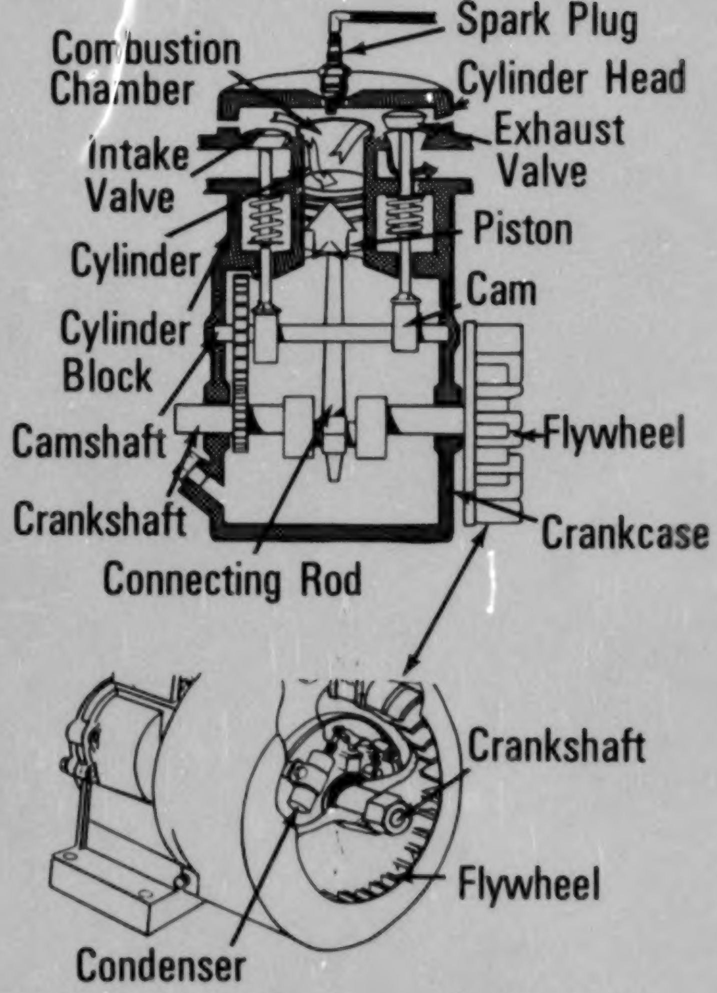
XI. Information found on name plate

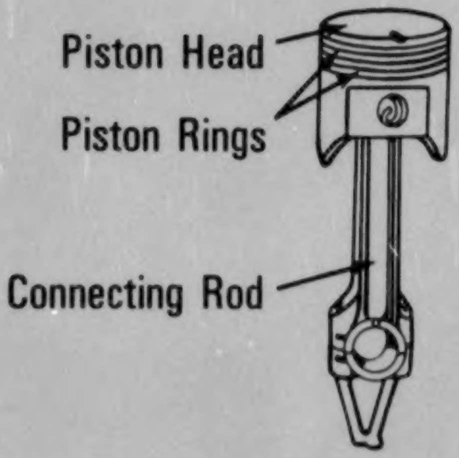
- A. Make of engine
- B. Model number
- C. Serial number
- D. Specification number
- E. Size
- F. RPM


WISCONSIN
HEAVY-DUTY
Air-Cooled
ENGINE ®
MODEL
TR 10 D
SERIAL NO.
3884026
SIZE
3x2
R.P.M.
2800
SPEC. NO.
3267D
WISCONSIN MOTOR CORPORATION
MILWAUKEE, WISC. U.S.A.

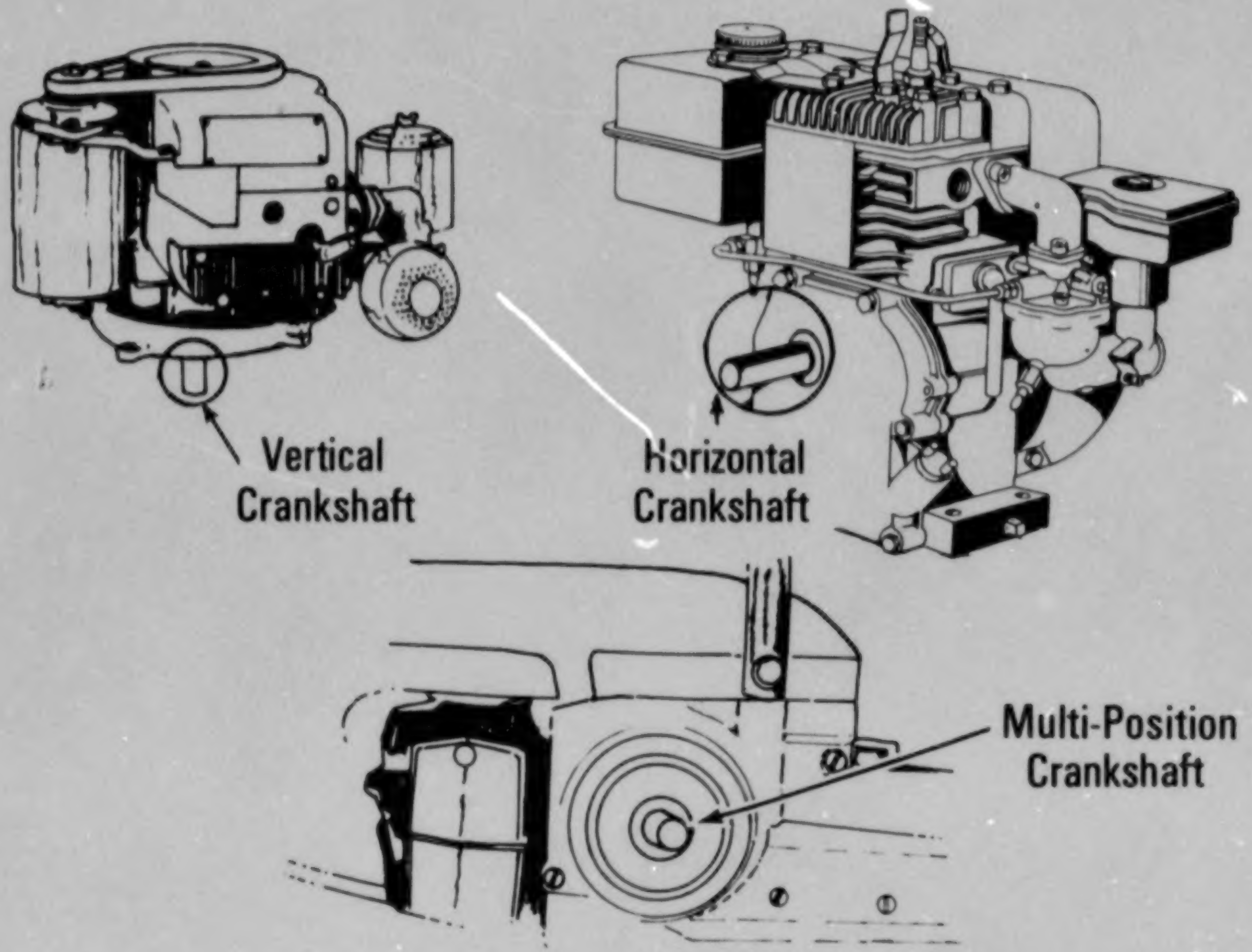
Small Engine Parts


Fuel Tank
Spark Plug
Cylinder Head
Cylinder Block
Crankcase
Crankshaft
Air Cleaner
Carburetor
Oil Filler Plug

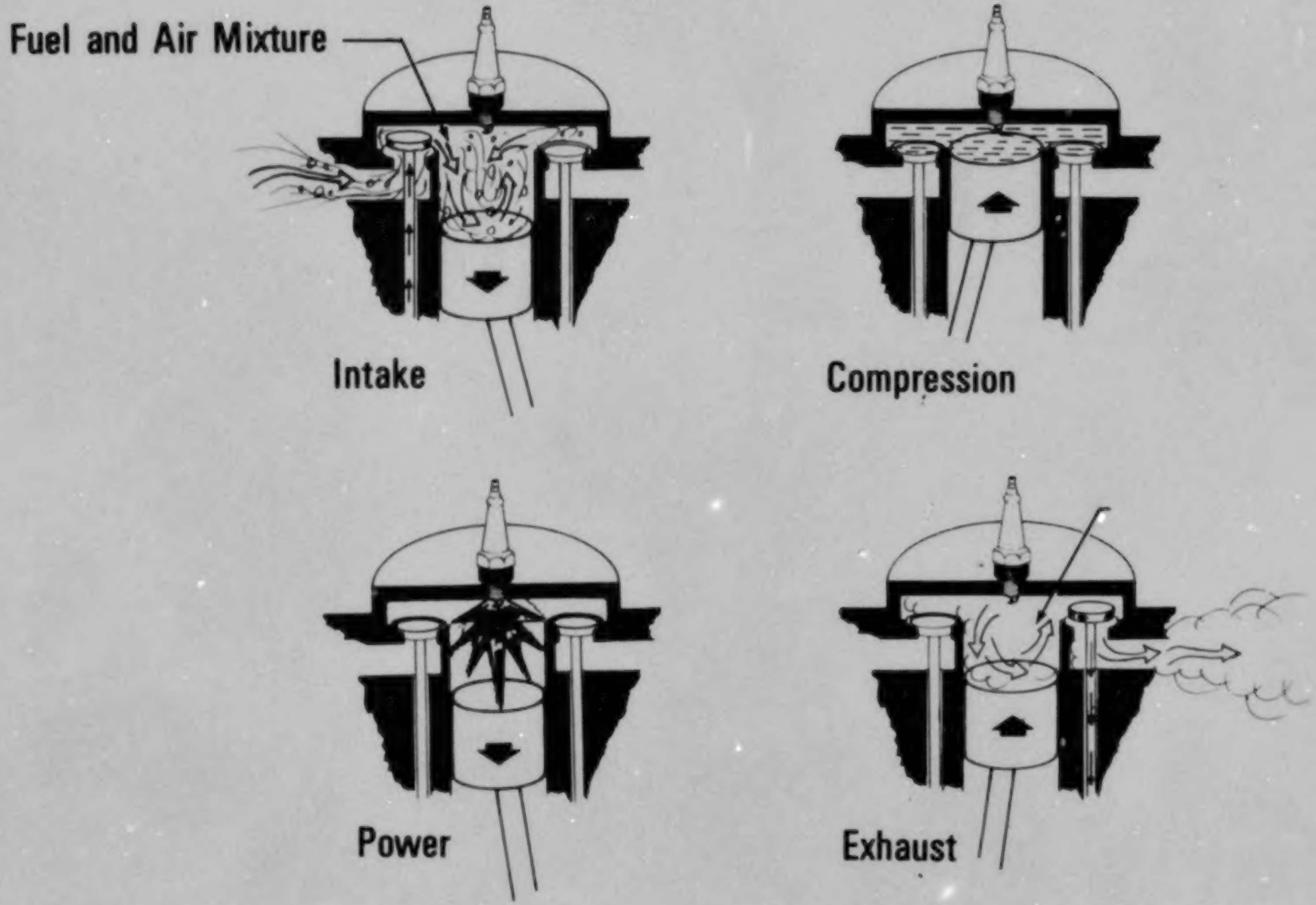

Spark Plug
Combustion Chamber
Cylinder Head
Intake Valve
Exhaust Valve
Piston
Cylinder
Cam
Cylinder Block
Flywheel
Camshaft
Crankshaft
Crankcase
Connecting Rod
Crankshaft
Flywheel
Condenser


Piston Head
Piston Rings
Connecting Rod

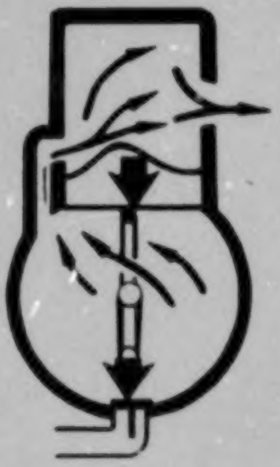
Engine Operating Positions


Vertical Crankshaft
Horizontal Crankshaft
Multi-Position Crankshaft

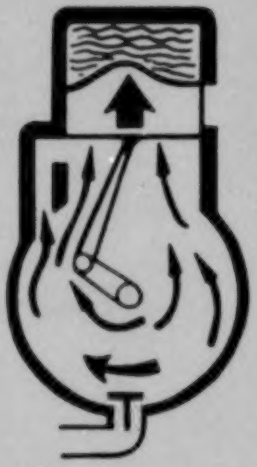
Events of a Four-Cycle Engine


Fuel and Air Mixture
Intake
Compression
Power
Exhaust

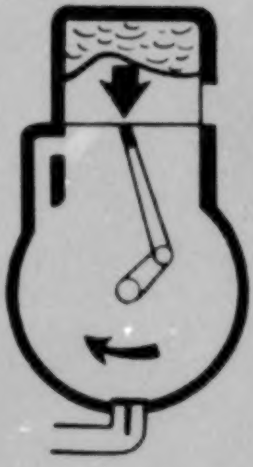
Events of a Two-Cycle Engine



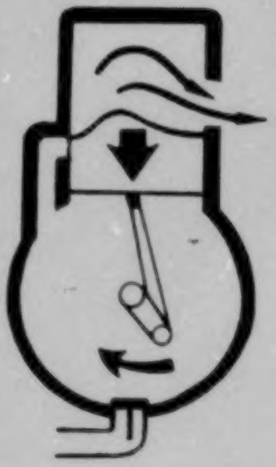
Intake



Compression

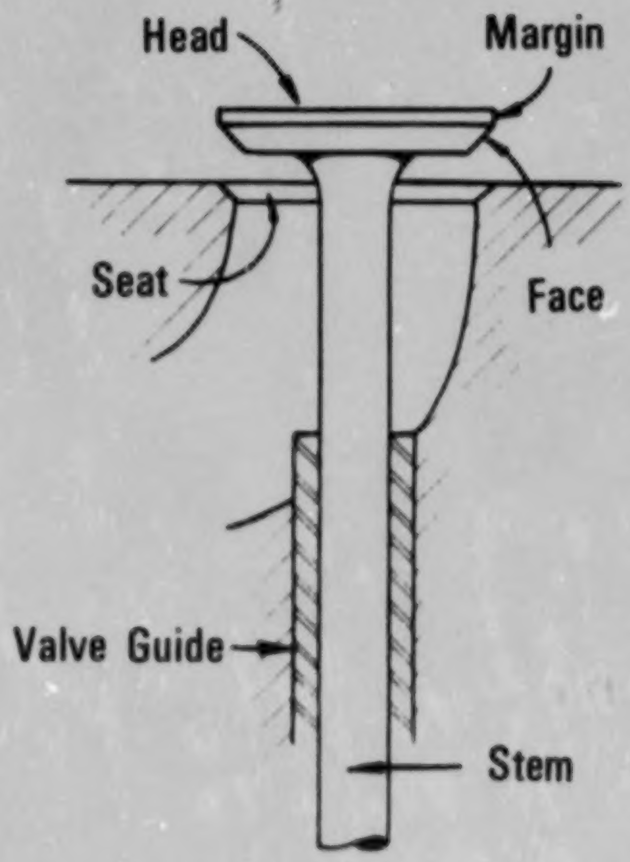


Power



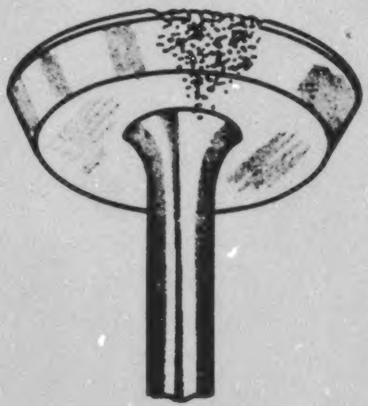
Exhaust

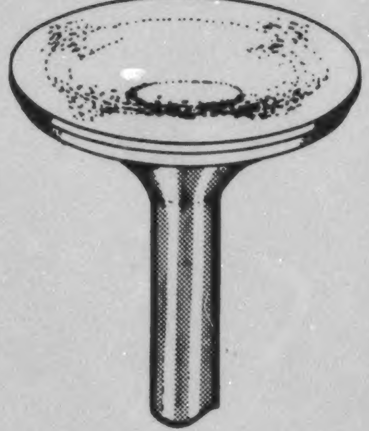
Valve Parts


Head
Margin
Seat
Face
Valve Guide
Stem

Types of Valve Failures

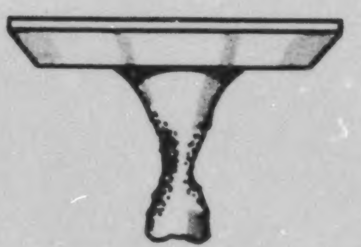
Burned





Dished

Necked



ENGINE OPERATION
UNIT I

ASSIGNMENT SHEET #1--ENGINE INSPECTION CHART

Engine: Make ________________ Model ________________ Serial No.__________

Specification Number ________________ Horsepower ______________________

Operating Position of Crankshaft: Vertical ______, Horizontal ______,

Multi-Position ______.

Engine Cycle: 2-Cycle ______, 4-Cycle ______.

TYPES OF ACCESSORIES AND MAJOR UNITS:

CARBURETOR AIR CLEANER: Oil bath ☐, Oiled filter ☐, Dry filter ☐.

FUEL STRAINER: Combination screen and sediment bowl ☐, Screen inside the fuel tank ☐.

CRANKCASE BREATHER: Reed valve ☐, Floating disk valve ☐.

STARTER: Rope-wind ☐, Rope-rewind ☐, Wind up ☐, Electric, AC ☐, Electric, DC ☐.

IGNITION SYSTEM: Flywheel magneto ☐, External magnet ☐, Battery ☐.

FUEL PUMP: Mechanically driven ☐, Differential pressure driven ☐.

CARBURETOR: Float ☐, Suction lift ☐, Diaphragm ☐.

GOVERNOR: Air vane ☐, Centrifugal ☐.

ASSIGNMENT SHEET #1

ITEM		STANDARD	ACTUAL	RECOMMENDATION	Parts No.
CYLINDER	Diameter				
	Out of Round	0			
	Taper	0			
RING GROOVE SIDE CLEARANCE					
RING END GAP	Compression				
	Oil				
CRANKSHAFT	*Magneto Journal				
Diameter	*Crankpin				
	*P.T.O. Journal				
	Magneto Journal	0			
Out of Round	Crankpin	0			
	P.T.O. Journal	0			
MAIN BEARINGS	Magneto Journal	Use go, no go gauge			
	P.T.O. Journal	Use go, no go gauge			
VALVE MARGIN		1/32"			
VALVE GUIDE		Use go, no go gauge			
BREAKER POINT PLUNGER HOLE		Use go, no go gauge			
TAPPET CLEARANCE	Intake				
	Exhaust				
BREAKER POINT GAP					
SPARK PLUG GAP					
ARMATURE AIR GAP					

ENGINE OPERATION
UNIT I

JOB SHEET #1–DISASSEMBLE A SMALL GASOLINE ENGINE

I. Tools and materials needed

  A. 4-cycle engine

  B. 3/8" drive socket set

  C. Combination wrench set

  D. Standard screwdriver

  E. Soft mallet

  F. Adjustable wrench

  G. Punches

  H. Ring compressor

  I. Flywheel puller

  J. Starter wrench

  K. Flywheel holder

  L. Spring compressor

  M. Container for holding parts

II. Procedure

  A. Drain oil

  B. Remove air cleaner stud and wing nut

  C. Remove fuel line

  D. Remove carburetor and linkage

  E. Remove carburetor intake elbow

  F. Remove muffler if necessary

  G. Check space between carburetor bodies on two-piece carburetor

  H. Remove shroud and check rewind starter

JOB SHEET #1

I. Check compression
J. Remove spark plug
K. Check air gap, armature to flywheel
L. Remove governor blade
M. Remove breather assembly
N. Remove cylinder head and shield
O. Check tappet clearance
P. Remove valves and springs
Q. Remove starter pulley or clutch
R. Remove flywheel
S. Remove breaker point cover
T. Check contact point gap
U. Remove breaker points and check plunger hole
V. Check end play
W. File burrs from crankshaft power take-off end
X. Remove base or sump
Y. Remove oil slinger and bracket
Z. Remove cam gear
AA. Remove tappets
BB. Remove connecting rod and piston
CC. Remove crankshaft
DD. Test condenser
EE. Test coil
FF. Check cylinder bore, valve guides, and bearings
GG. Remove piston from connecting rod

JOB SHEET #1

HH. Check piston, rings, and piston pin

II. Reface valves

JJ. Re-seat valve seats

ENGINE OPERATION
UNIT I

JOB SHEET #2--REASSEMBLE A SMALL GASOLINE ENGINE

I. Tools and materials needed

- A. 3/8" drive socket set
- B. Combination wrench set
- C. Standard screwdriver
- D. Soft mallet
- E. Adjustable wrench
- F. Punch
- G. Ring compressor
- H. Starter wrench
- I. Flywheel holder
- J. Spring compressor

II. Procedure

- A. Install crankshaft
- B. Assemble piston pin and connecting rod
- C. Assemble rings to piston
- D. Install piston and connecting rod assembly
- E. Install tappets
- F. Install cam gear
- G. Install oil slinger, gear, and bracket
- H. Install base or sump with gasket
- I. Check and adjust end play
- J. Install points, adjust gap, and clean
- K. Install point cover

JOB SHEET #2

L. Install flywheel

M. Install starter pulley or clutch

N. Install governor blade

O. Adjust armature air gap

P. Check spark

Q. Adjust valve tappet clearance

R. Install valves, springs, and retainers

S. Recheck valve tappet clearance

T. Install breather assembly

U. Install cylinder head and shield

V. Test, clean, gap, and install spark plug

W. Check compression

X. Install muffler

Y. Install carburetor and linkage

Z. Check and align governor

AA. Install shroud housing

BB. Install fuel pipe

CC. Fill with oil

DD. Adjust carburetor

EE. Start engine

ENGINE OPERATION
UNIT I

TEST

1. Match these terms with the correct definition.

_____a. A scratch, ridge, or groove marring a finished surface

_____b. The total distance traveled by the piston in either direction

_____c. The lowest position the piston can go

_____d. The process of burning fuel and air

_____e. The space between the electrodes of a spark plug through which the spark jumps

_____f. The pressing or squeezing together of the fuel and air in an engine

_____g. The highest position the piston can go

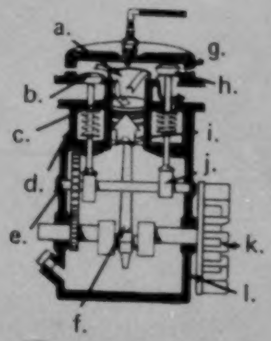
_____h. A device consisting of a control which is used to regulate engine speed

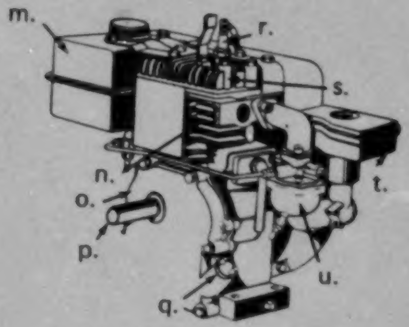
_____i. Anything used as a packing, such as a non-metallic substance placed between two metal surfaces to act as a seal

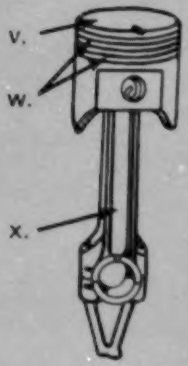
1. B.D.C.
2. Combustion
3. Compression
4. Gasket
5. Governor
6. Score
7. Spark gap
8. Stroke
9. T.D.C.

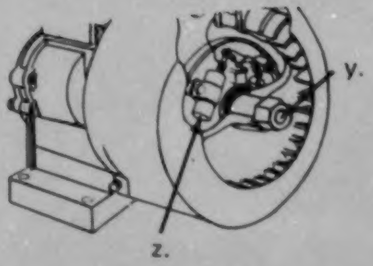
2. Match the names with the small engine parts shown in these drawings. Some answers will be used more than once.

______a.
______b.
______c.
______d.
______e.
______f.
______g.
______h.
______i.
______j.
______k.
______l.
______m.
______n.
______o.
______p.
______q.
______r.
______s.
______t.
______u.
______v.
______w.
______x.
______y.
______z.









1. Air cleaner
2. Cam
3. Camshaft
4. Carburetor
5. Combustion chamber
6. Condenser
7. Connecting rod
8. Crankcase
9. Crankshaft
10. Cylinder
11. Cylinder block
12. Cylinder head
13. Exhaust valve
14. Fuel tank
15. Flywheel
16. Intake valve
17. Oil filler plug
18. Piston
19. Piston head
20. Piston rings
21. Spark plug
22. Valve

3. Name five machines that are powered by a small gasoline engine.

a.

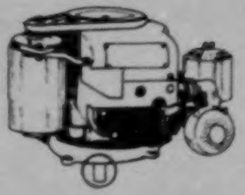
b.

c.

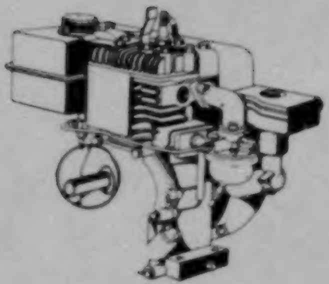
d.

e.

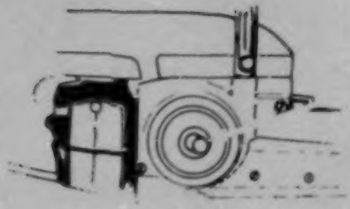
4. Identify the operating position of each engine from the drawings below.



a. ________________



b. ________________



c. ________________

5. Name and describe the four principal events in the operation of a 4-cycle engine.

a.

b.

c.

d.

6. What is the difference between a 4-cycle and a 2-cycle engine?

7. Name three advantages of an air-cooled engine.

a.

b.

c.

8. What is one way of making a very simple compression test?

9. Match the valve parts with the correct name.

______a.

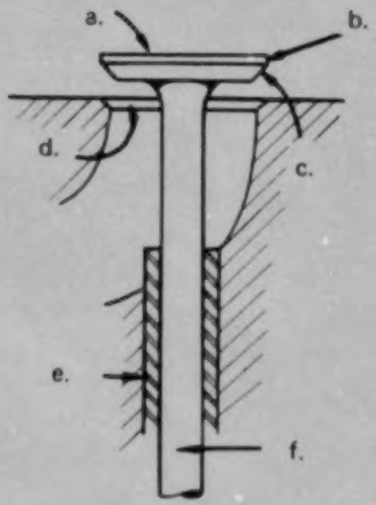
______b.

______c.

______d.

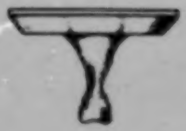
______e.

______f.

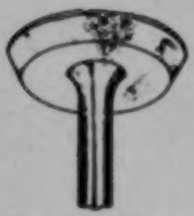


1. Face
2. Head
3. Margin
4. Seat
5. Stem
6. Valve guide

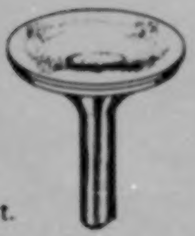
10. Identify the following types of valve failures.



a. ______________



b. ______________



c. ______________

11. Complete an engine inspection chart.

12. Demonstrate the ability to:

   a. Disassemble a small gasoline engine.

   b. Reassemble a small gasoline engine.

(NOTE: If activities 11 and 12 have not been accomplished prior to the test, ask your instructor when they should be completed.)

ENGINE OPERATION
UNIT I

ANSWERS TO TEST

1. a. 6
   b. 8
   c. 1
   d. 2
   e. 7
   f. 3
   g. 9
   h. 5
   i. 4
2. a. 5
   b. 16
   c. 10
   d. 11
   e. 3
   f. 7
   g. 12
   h. 13
   i. 18
   j. 2
   k. 15
   l. 8
   m. 14
   n. 11

o. 8

p. 9

q. 17

r. 21

s. 12

t. 1

u. 4

v. 19

w. 20

x. 7

y. 9

z. 6

3. Any five of the following:

   a. Motorcycles

   b. Chain saws

   c. Mowers

   d. Outboard motors

   e. Pumps

   f. Posthole diggers

   g. Elevators

4. a. Vertical

   b. Horizontal

   c. Multi-position

5. a. Intake--Exhaust valve is closed; intake valve is open; piston moves downward and the air-fuel mixture is drawn into the cylinder

   b. Compression--Intake valve closes; piston moves upward; air-fuel mixture is compressed

c. Power--Spark occurs igniting the mixture; forces of expanding gases push the piston down

d. Exhaust--Exhaust valve opens; upward movement of piston forces burned gases out of cylinder; exhaust valve closes; cycle is repeated

6. a. 4-cycle-Two revolutions of crankshaft per firing; lubricated from crankcase oil in the sump

b. 2-cycle--One revolution of crankshaft per firing; lubricated from oil mixed with the gasoline

7. a. No need for complicated cooling system

b. Lighter in weight and occupies less space

c. Easy to repair

8. Give the flywheel a quick spin and if it rebounds on the compression stroke, the compression is at least good enough to start the engine

9. a. 2

b. 3

c. 1

d. 4

e. 6

f. 5

10. a. Necked

b. Burned

c. Dished

11. - 12. Performance skills will be evaluated to the satisfaction of the instructor.

SERVICING SMALL ENGINES
UNIT II

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to match terms and definitions associated with servicing small engines. He should be able to identify the different types of air cleaners, fuel strainers, and carburetors and demonstrate skills in servicing small gasoline engines. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match five terms and definitions associated with servicing small engines.
2. Name three solutions used in cleaning an engine.
3. Identify given types of air cleaners.
4. Identify given types of fuel filters.
5. Identify given types of carburetors.
6. Demonstrate the procedures for performing the following jobs:
    a. Clean and inspect crankcase and accessories.
    b. Clean and inspect cooling system.
    c. Service air cleaners.
    d. Service fuel filters.
    e. Clean crankcase breather.
    f. Change crankcase oil.
    g. Check spark plug for proper operation.
    h. Clean and service spark plugs.

SERVICING SMALL ENGINES
UNIT II

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Make transparencies.

   D. Discuss terminal and specific objectives.

   E. Discuss information sheet.

   F. Demonstrate and discuss procedures outlined in job sheets.

   G. Give test.

II. Students:

   A. Read objectives.

   B. Study information sheets.

   C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objectives

   B. Information sheet

   C. Transparency masters

      1. TM 1--Types of Air Cleaners

      2. TM 2--Types of Fuel Filters

      3. TM 3--Types of Carburetors

D. Job sheets

1. Job Sheet #1--Clean and Inspect Crankcase and Accessories
2. Job Sheet #2--Clean and Inspect Cooling System
3. Job Sheet #3--Service Oil-Bath Air Cleaner
4. Job Sheet #4--Service Oil-Filter Air Cleaner
5. Job Sheet #5--Service Dry-Filter Air Cleaner
6. Job Sheet #6--Service Sediment-Bowl Fuel Filter
7. Job Sheet #7--Service Screen-Type Fuel Filter
8. Job Sheet #8--Service Crankcase Breather
9. Job Sheet #9--Change Crankcase Oil
10. Job Sheet #10--Check Spark Plug for Proper Operation
11. Job Sheet #11--Service Spark Plugs

E. Test

F. Answers to test

II. References:

A. *Small Engines Care, Operation, Maintenance, and Repair,* Volume I. Athens, Georgia: American Association for Agricultural Engineering and Vocational Agriculture, 1968.

B. *Briggs and Stratton Repair Instructions II.* Milwaukee, Wisconsin: Briggs and Stratton Corporation.

C. *General Theories of Operation.* Milwaukee, Wisconsin: Briggs and Stratton Corporation.

D. *Small Gasoline Engines Student Handbook.* University Park, Pennsylvania: Pennsylvania State University, College of Agriculture, Department of Agricultural Education, 1969.

SERVICING SMALL ENGINES
UNIT II

INFORMATION SHEET

I. Terms and definitions

  A. Butterfly (throttle) valve--A device located in the manifold which controls the fuel and air

  B. Choke valve--A gate or valve which allows passage of gas or fluid in one direction only

  C. Spark gap--The space between the electrodes of a spark plug through which the spark jumps

  D. Detonation or knock--A hammering force on the piston rather than a uniform pushing force

  E. Air cleaner--A device for filtering, cleaning, and removing dust from the air admitted to a unit such as an engine

II. Engine cleaning solutions

  A. Commercial solvent called *degreaser*

  B. Petroleum solvents

    1. Kerosene

    2. Diesel fuel

  C. Live steam

III. Types of air cleaners (Transparency 1)

  A. Oil-bath

  B. Oil-filter

  C. Dry-filter

IV. Types of fuel filters (Transparency 2)

  A. Combination screen and sediment bowl

  B. Screen in fuel tank

  C. Screen at end of fuel pickup hose

INFORMATION SHEET

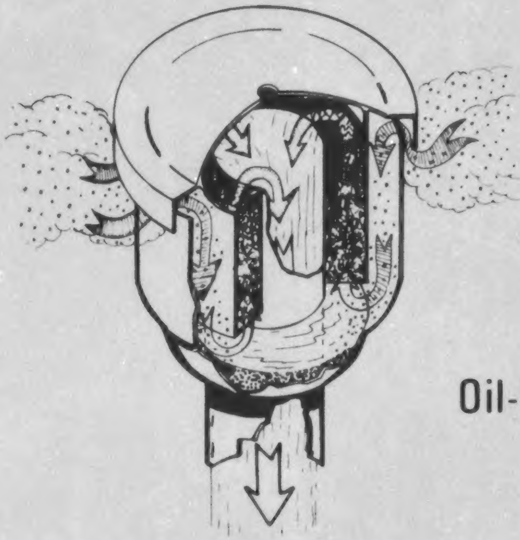
V. Types of carburetors (Transparency 3)

   A. Float

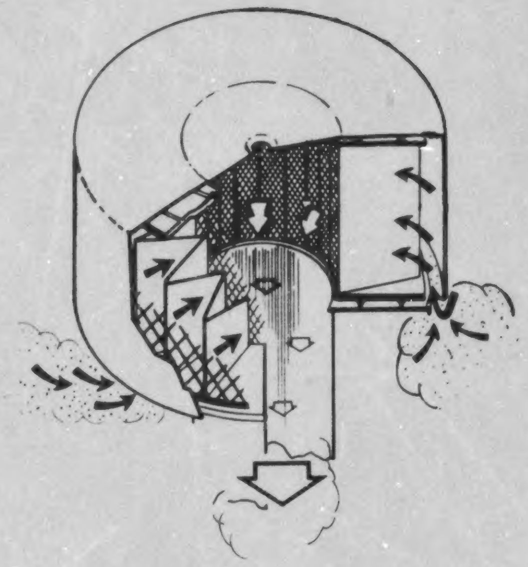
   B. Suction-lift

   C. Diaphragm

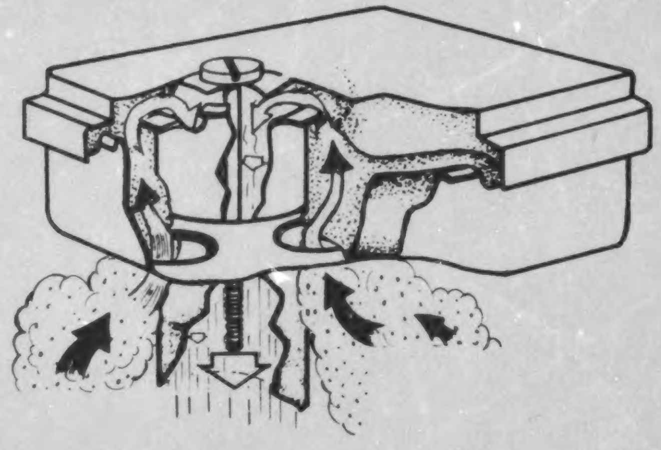
Types of Air Cleaners



Oil-Bath

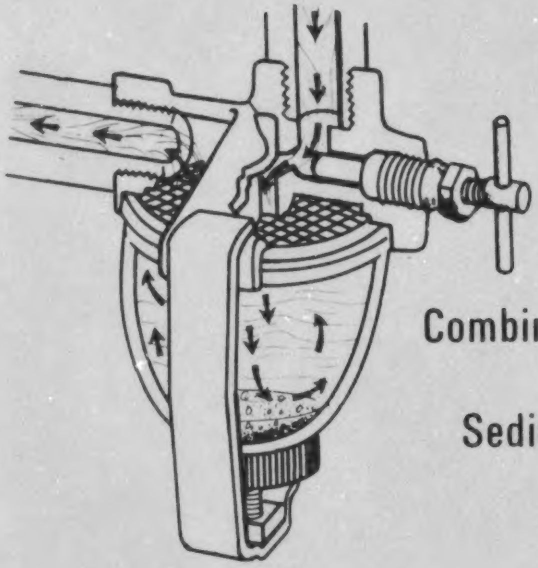


Dry-Filter

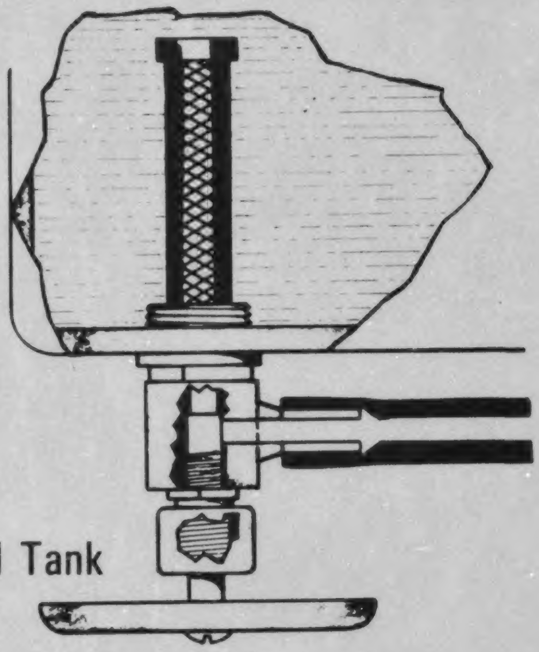


Oiled-Filter

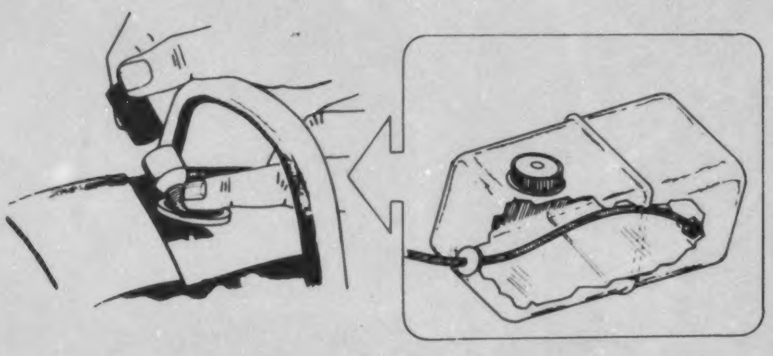
Types of Fuel Filters



Combination Screen
and
Sediment Bowl

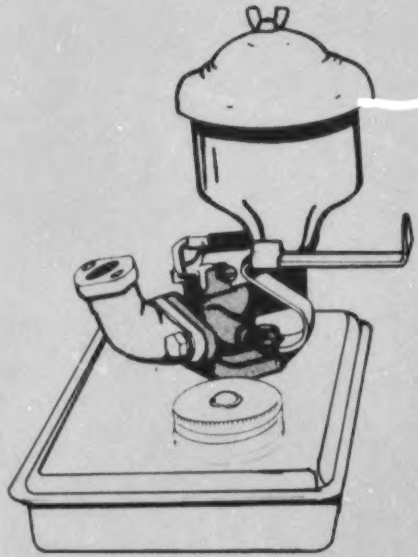


Screen in Fuel Tank

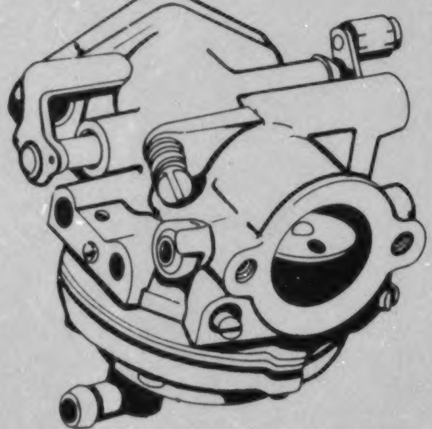


Strainer on Fuel
Pick-up Hose

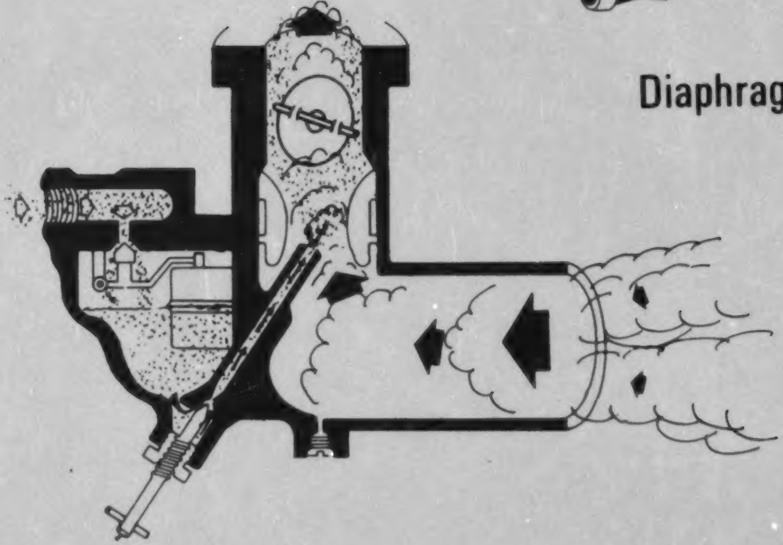
Types of Carburetors



Suction-Lift



Diaphragm



Float

SERVICING SMALL ENGINES
UNIT II

JOB SHEET #1–CLEAN AND INSPECT CRANKCASE AND ACCESSORIES

I. Tools and materials needed

  A. Standard screwdrivers 4" and 6"

  B. Phillips screwdrivers 4" and 6"

  C. Socket set including:

    1. 3/8"
    2. 7/16"
    3. 1/2"
    4. 5/8"
    5. 9/16"
    6. 3/8" ratchet

  D. Open-end wrenches same as sockets

  E. Wire brush

  F. Empty pan for cleaning

  G. Paint brush

  H. Water hose with nozzle

  I. Scraper or putty knife

  J. Solvent

  K. Hand spray

(NOTE: Do not use gasoline for cleaning an engine. It is highly flammable and an extreme fire hazard. If a degreaser is used, check the instructions on the can.)

II. Procedures

  A. Allow the engine to cool if it has been running

  B. Remove the blower shroud and cylinder baffles

JOB SHEET #1

C. Inspect for oil and fuel leaks

D. Remove air-cleaner and cover air-cleaner opening

(NOTE: Cover carburetor intake with a piece of plastic sheeting. Use a rubber band to hold plastic in place.)

E. Clean the exhaust system

F. Apply solvent on areas that need cleaning

(NOTE: Apply with a paint brush or hand sprayer until you notice a thin, well-distributed film.)

G. Allow solvent to set approximately five minutes

H. Remove solvent from the engine surface

1. If you used a degreaser, apply a strong stream of water
2. If you used a petroleum solvent, remove with a strong soap solution

I. Check for areas that have been missed

I. Remove protective covers

K. Replace carburetor air-cleaner

L. Start engine and operate for three to five minutes

SERVICING SMALL ENGINES
UNIT II

JOB SHEET #2–CLEAN AND INSPECT COOLING SYSTEM

I. Tools and materials needed

  A. Standard screwdrivers 4" and 6"

  B. Phillips screwdrivers 4" and 6"

  C. Socket set

  D. Open-end wrench set

  E. Wire brush

  F. Scraper or putty knife

II. Procedures

  A. Close the fuel shut-off valve

  (NOTE: Not all engines have shut-off valves. If there is one, it may be either a part of the sediment bowl or a single unit.)

  B. Remove fuel tank if necessary for removing the flywheel shroud

  C. Remove the recoil starter or screened sheave if equipped with a self-starter

  D. Remove the blower shroud

  E. Remove remaining baffles and deflectors that direct air from shroud and over end area of cylinder

  (NOTE: Do not operate the engine with the shroud and baffles removed.)

  F. Clean inside of shroud and baffles with a small bristle brush or a putty knife

  G. Clean intake screen by washing in solvent

  H. Clean dirt from cylinder fins

  I. Clean dirt from blower flywheel fins

  J. Inspect engine for cracks, blemishes, and broken parts

  K. Reassemble parts in reverse order

SERVICING SMALL ENGINES
UNIT II

JOB SHEET #3–SERVICE OIL-BATH AIR CLEANER

I. Tools and materials needed

   A. Standard screwdrivers 4" and 6"

   B. Phillips screwdrivers 4" and 6"

   C. Container for washing parts

   D. Clean rags

   E. Wooden scraper

   F. Paint brush

   G. Solvent

   (NOTE: Do not use gasoline, naptha, or benzine. They are extremely flammable.)

II. Procedures

   A. Disconnect the spark plug wire

   B. Loosen oil cup or cover, and remove the air cleaner

      1. Secured by bail wire

      2. Secured by wing nut

      3. Secured by threaded stud

   C. Cover the exposed air intake

   D. Check depth of sediment deposit in bottom of oil cups

   E. Throw away dirty oil

   F. Clean cup, filter, and other parts with solvents

   G. Check air intake pipe to the carburetor for dirt accumulation

   H. Refill cap with oil to *oil level*

   I. Remove cover from intake

   J. Assemble the air cleaner; install and tighten

   K. Reconnect the spark plug wire

SERVICING SMALL ENGINES
UNIT II

JOB SHEET #4--SERVICE OIL-FILTER AIR CLEANER

I. Tools and materials needed

  A. Standard screwdrivers 4" and 6"

  B. Phillips screwdrivers 4" and 6"

  C. Container for washing parts

  D. Clean rags

  E. Soap

  F. Paint brush

II. Procedures

  A. Disconnect the spark plug wire

  B. Clean area around air cleaner

  C. Remove filter element cover

  D. Remove filter element

  E. Check condition of the filter element and other parts of the air cleaner

  F. Cover carburetor air intake

  B. Clean filter

  H. Dry filter element

  I. Remove protective cover from the carburetor intake

  J. Clean the carburetor intake

  K. Oil the filter element with a few drops of oil

  L. Install filter element

  M. Install cover

  N. Reconnect spark plug wire

SERVICING SMALL ENGINES
UNIT II

JOB SHEET #5--SERVICE DRY-FILTER AIR CLEANER

I. Tools and materials needed

   A. Standard screwdrivers 4" and 6"

   B. Phillips screwdrivers 4" and 6"

   C. Clean rags

II. Procedures

   A. Disconnect the spark plug wire

   B. Clean the area around the air cleaner

   C. Remove the filter element cover

   D. Remove the air filter element

   E. Cover the carburetor air intake with cloth or plastic

   F. Check condition of filter element and other parts

   G. Clean air filter element

   (NOTE: If filter element is paper, clean by tapping it on a flat surface.)

   (CAUTION: Do not wash it unless instructed to do so by the manufacturer.)

   H. Remove protective cover from the carburetor intake

   I. Clean filter cover and carburetor intake

   J. Replace filter element

   K. Replace cover

   L. Reconnect spark plug wire

SERVICING SMALL ENGINES
UNIT II

JOB SHEET #6--SERVICE SEDIMENT-BOWL FUEL FILTER

I. Tools and materials needed

   A. Open-end wrenches 7/16" and 1/2"

   B. Combination pliers

   C. Solvents

   D. Pan for cleaning parts

   E. Cleaning rags

   F. New gasket for glass bowl

II. Procedures

   A. Disconnect spark plug wire

   B. Close fuel shut-off valve

   C. Loosen jam nut and swing the wire bail to one side (Figure A)

   D. Remove bowl with a twisting motion (Figure A)

   E. Remove gasket (Figure A)

   F. Remove strainer (filter) screen (Figure A)

   G. Wash the screen or filter element

   H. Clean and then dry sediment bowl

   I. Open fuel valve and drain out approximately a cup of fuel (Figure B) (NOTE: Collect fuel in can to avoid a fire hazard.)

   J. Install gasket, strainer, and sediment bowl (Figure C)

   K. Fill the sediment bowl before tightening the jam nut

   L. Tighten bowl against gasket with jam nut

   M. Check for leaks before operating engine

JOB SHEET #6

N. Reconnect spark plug wire to spark plug

O. Operate engine for a few minutes and recheck for leaks

III. Diagram of procedure

Figure A

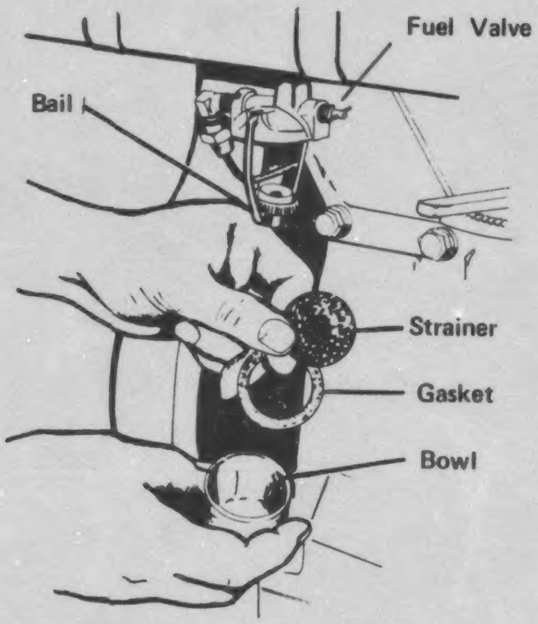

Fuel Valve
Bail
Strainer
Gasket
Bowl

Figure B

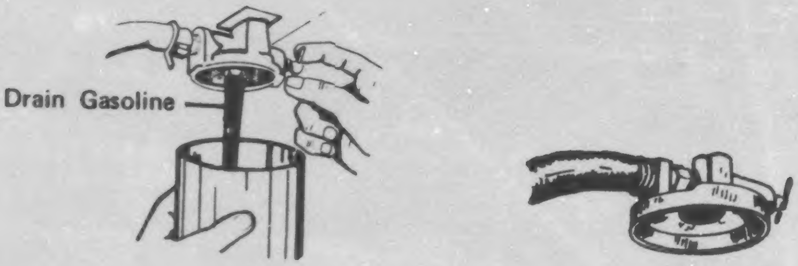
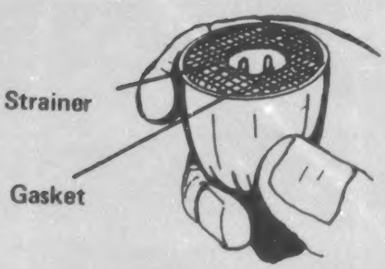

Drain Gasoline

Figure C


Strainer
Gasket

SERVICING SMALL ENGINES
UNIT II

JOB SHEET #7--SERVICE SCREEN-TYPE FUEL FILTER

I. Tools and materials needed

  A. Open-end wrenches 7/16" and 1/2"

  B. Combination pliers

  C. Solvent

  D. Pan for cleaning parts

  E. Cleaning rags

II. Procedures

  A. Disconnect the spark plug wire

  B. Close fuel shut-off valve (if one is installed)

  C. Remove fuel line from tank

  D. Remove fuel shut-off valve and/or fuel filter (strainer) from fuel tank if possible

  E. Clean fuel strainer

  F. Replace fuel strainer assembly in reverse order of removal

  G. Reconnect spark plug wire to spark plug

SERVICING SMALL ENGINES
UNIT II

JOB SHEET #8--SERVICE CRANKCASE BREATHER

I. Tools and materials needed

- A. Open-end wrenches 7/16" and 1/2"
- B. Standard screwdriver 8"
- C. Combination pliers
- D. Clean rags
- E. Solvent
- F. Container for cleaning parts
- G. New gasket

II. Procedures

- A. Disconnect spark plug wire
- B. Check breather for proper operation
- C. Remove crankcase breather cover, if installed (Figure A)
- D. Remove the crankcase breather, if it is not a part of the cover
- E. Check breather valve for clearance (Figure B)
    - 1. Check reed valves with a feeler gauge
    - 2. Clearance should be .015" to .030"
- F. Disassemble crankcase breather (Figure C)
- G. Clean parts in petroleum solvent
- H. Reassemble and install breather

JOB SHEET #8

III. Diagram of procedure

Figure A

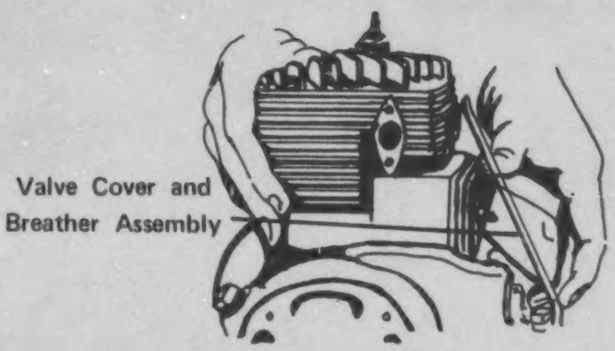

Valve Cover and
Breather Assembly

Figure B

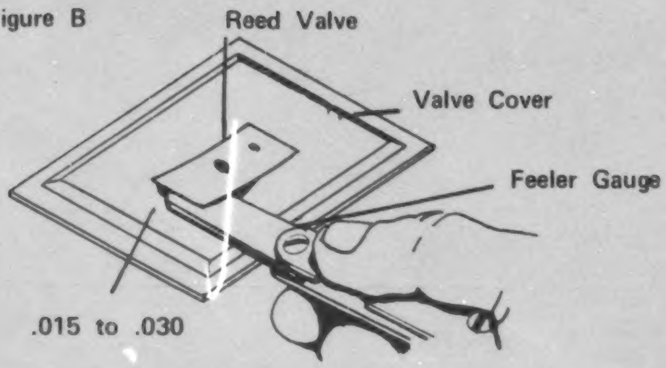
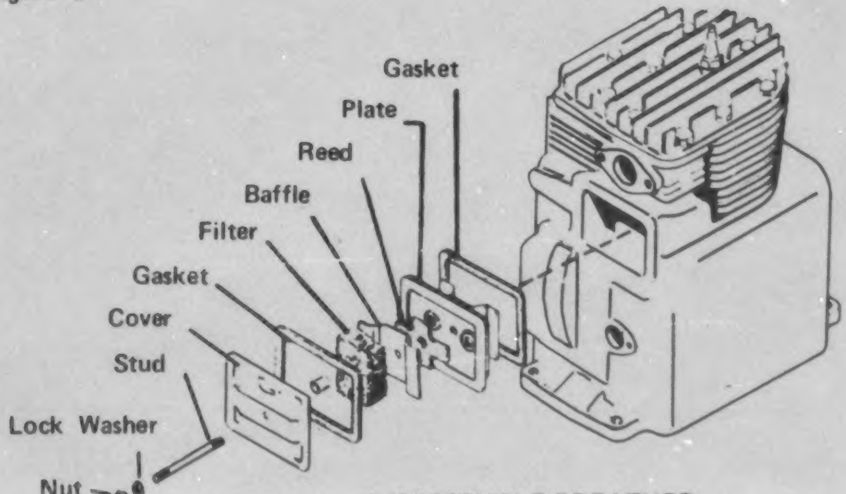

Reed Valve
Valve Cover
Feeler Gauge
.015 to .030

Figure C


Gasket
Plate
Reed
Baffle
Filter
Gasket
Cover
Stud
Lock Washer
Nut

DISASSEMBLE BREATHER

SERVICING SMALL ENGINES
UNIT II

JOB SHEET #9--CHANGE CRANKCASE OIL

I. Tools and materials needed

   A. Standard screwdriver 8"

   B. Combination pliers

   C. End wrenches 7/16", 1/2", 9/16", and 5/8"

   D. Funnel

   E. Oil as recommended

   F. Container for old oil

   G. Clean rags

II. Procedure

   A. Operate engine until it is thoroughly heated

   B. Stop engine and disconnect the spark plug wire

   C. Locate drain plug (Figure A)

      1. Bottom of oil sump

      2. Under oil sump

      3. Some drained through filler neck

   D. Clean dirt from around plug before removing plug

   E. Remove drain plug

   F. Allow crankcase to drain for approximately five minutes

   G. Replace drain plug

   H. Refill crankcase with new oil

   (NOTE: Use type of oil recommended in the operator's manual.)

   I. Connect spark plug wire and start engine

   J. Check for oil leaks

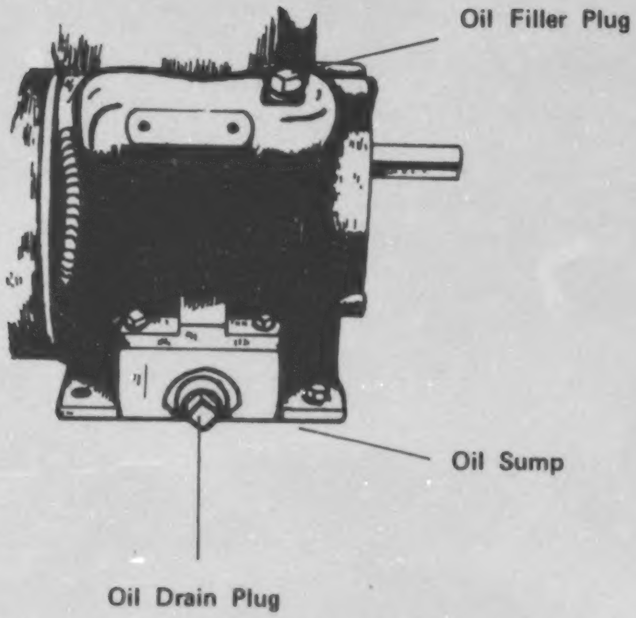
JOB SHEET #9

K. Stop engine

L. Recheck oil level

III. Diagram of procedure

Figure A


Oil Filler Plug
Oil Sump
Oil Drain Plug

SERVICING SMALL ENGINES
UNIT II

JOB SHEET #10--CHECK SPARK PLUG FOR PROPER OPERATION

I. Tools and materials needed

A. Spark plug deep sockets 13/16" x 3/8" and 3/4" x 3/8" drive

B. Torque wrench handle 3/8" drive

C. Feeler gauge

D. Ignition file

E. Penknife

F. Wire brush

G. Small paint brush

H. Pan of petroleum solvent

II. Procedures

A. Disconnect the spark plug wire from the spark plug (Figure A)

B. Loosen plug one or two turns, and then remove dirt

C. Remove the spark plug (Figure B)

D. Reconnect the spark plug wire

E. Ground spark plug to the engine (Figure C)

F. Crank the engine one or two turns

G. Observe the spark at the electrode

(NOTE: If there is no spark, or if spark is weak, proceed to next step.)

H. Disconnect the spark plug wire from the spark plug

I. Hold the end of the spark plug wire approximately 1/4 inch from the cylinder head, or use a spark tester (Figure D)

J. Crank the engine one or two turns

K. Observe the spark between spark plug wire and the cylinder head

(NOTE: If the spark is blue-orange color, the ignition system is okay; the trouble is in the spark plug.)

JOB SHEET #10

III. Diagram of procedure

Figure A

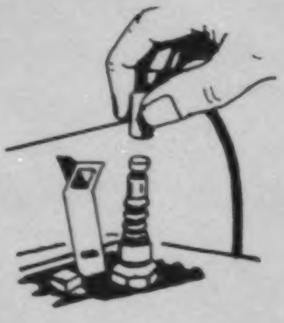
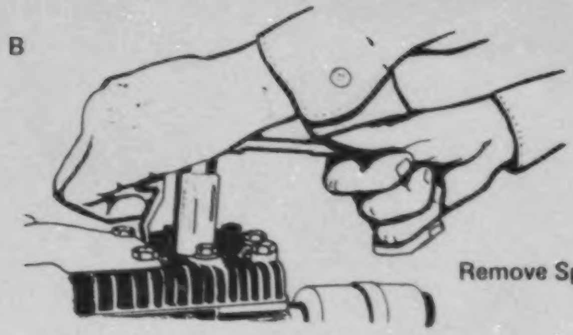
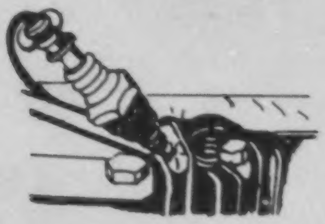

Metal Connector

Figure B



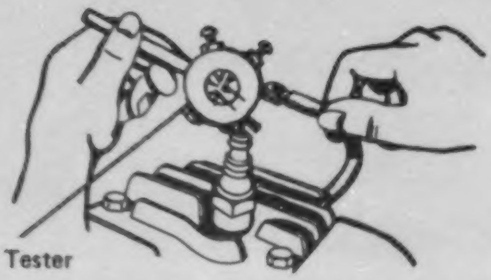
Remove Spark Plug

Figure C



Ground Spark Plug

Figure D


Adjustable Gap Spark Tester

SERVICING SMALL ENGINES
UNIT II

JOB SHEET #11--SERVICE SPARK PLUGS

I. Tools and materials needed

   A. Spark plug deep sockets 13/16" x 3/8" and 3/4" x 3/8" drive

   B. Torque wrench handle 3/8" drive

   C. Feeler gauge

   D. Ignition file

   E. Penknife

   F. Wire brush

   G. Small paint brush

   H. Pan of petroleum solvent

II. Procedures

   A. Check the condition of the plugs

   B. Remove oily deposits from plugs

   C. Clean threads with wire brush

      (NOTE: Do not brush the insulator. It will leave a metallic film which may provide an electrical short to ground.)

   D. Remove deposits from plugs (Figure A)

   E. Blow loose materials from plug with compressed air

   F. Bend the ground electrode enough to allow room for a thin point file (Figure B)

      (NOTE: Bend just enough to allow room for file; too much bending will break the ground electrode.)

   G. File electrodes on plugs until both have flat surfaces (Figure B)

   H. Bend the ground electrode back into its original position

   I. Determine proper spark gap spacing for your engine (Figure C)

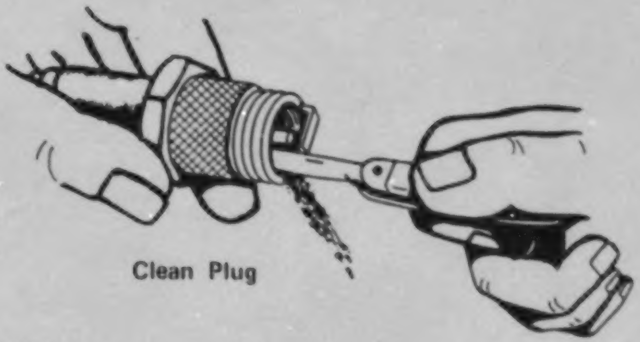
      1. Most plugs set on .025 inch

      2. Range from .020" to .040"

JOB SHEET #11

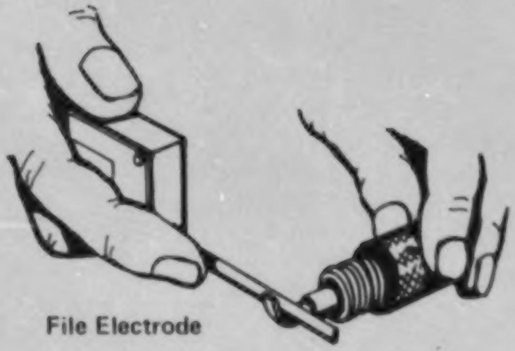
III. Diagram of procedure

Figure A



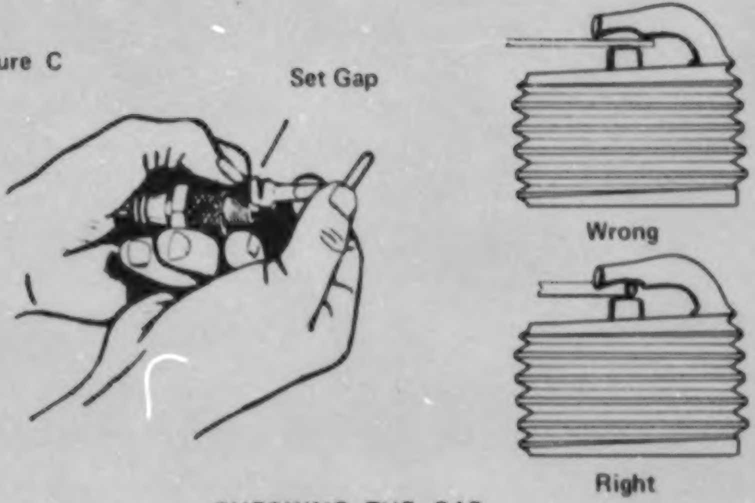
Clean Plug

Figure B



File Electrode

Figure C


Set Gap
Wrong
Right

CHECKING THE GAP

SERVICING SMALL ENGINES
UNIT II

TEST

1. Match the following terms with the correct definition.

_____a. A device located in the manifold which controls the fuel and air

_____b. A gate or valve which allows passage of gas or fluid in one direction only

_____c. The space between the electrodes of a spark plug through which the spark jumps

_____d. A hammering force on the piston rather than a uniform pushing force

_____e. A device for filtering, cleaning, and removing dust from the air admitted to a unit such as an engine

1. Air cleaner
2. Butterfly valve
3. Choke valve
4. Detonation or knock
5. Spark gap

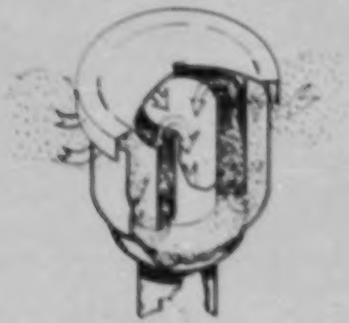
2. Name three solutions used in cleaning an engine.

a.

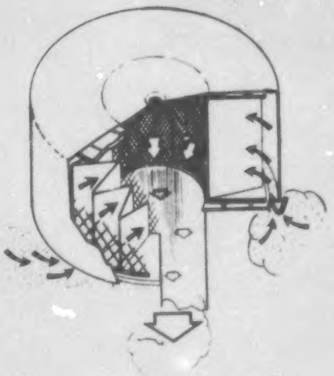
b.

c.

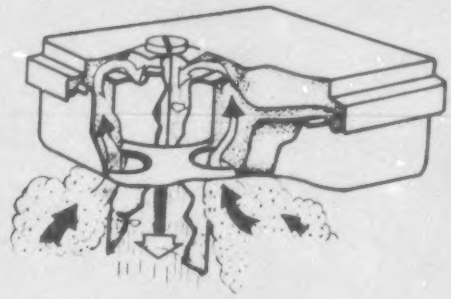
3. Identify the following types of air cleaners.



a.____________________

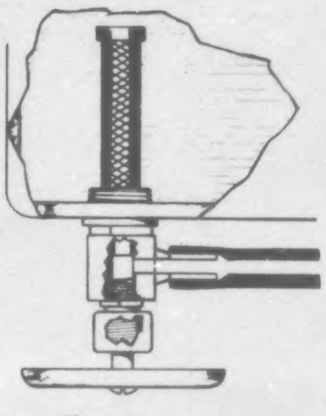


b.______________________

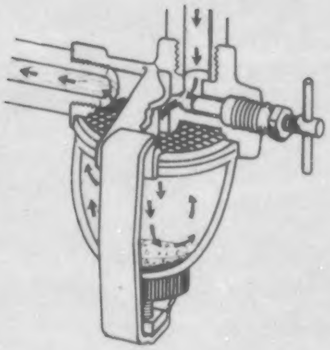


c.______________________

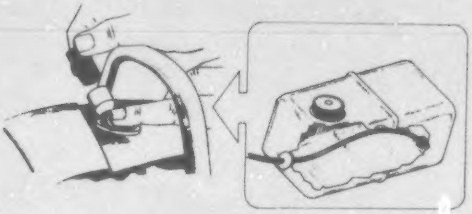
4. Identify the following types of fuel filters.



a.______________________

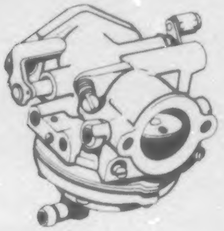


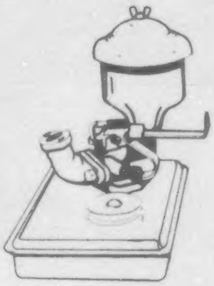
b.____________________



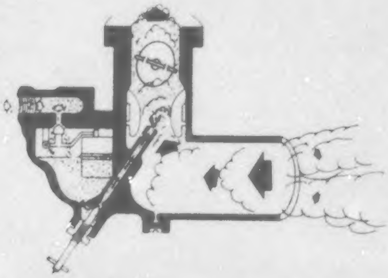
c.____________________

5. Identify the following types of carburetors.





a.____________________ b.____________________



c.____________________

6. Demonstrate the procedures for performing the following jobs.

   a. Clean and inspect crankcase and accessories.

   b. Clean and inspect cooling system.

   c. Service air cleaners.

   d. Service fuel filters.

   e. Clean crankcase breather.

   f. Change crankcase oil.

   g. Check spark plug for proper operation.

   h. Clean and service spark plugs.

   (NOTE: If this has not been completed prior to the test, ask the instructor when the above activities should be completed.)

SERVICING SMALL ENGINES
UNIT II

ANSWERS TO TEST

1. a. 2
   b. 3
   c. 5
   d. 4
   e. 1
2. a. Commercial solvent
   b. Petroleum solvents
   c. Live steam
3. a. Oil-bath
   b. Dry-filter
   c. Oil-filter
4. a. Screen in fuel tank
   b. Combination screen and sediment bowl
   c. Screen at end of fuel pickup hose
5. a. Diaphragm
   b. Suction-lift
   c. Float
6. Performance skills will be evaluated to the satisfaction of the instructor.

REPAIRING AND SHARPENING TOOLS
UNIT I

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to list sharpening equipment and discuss safety precautions to use in grinding. He should be able to sharpen and repair common shop tools. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. List three reasons for repairing and sharpening tools.
2. List four pieces of sharpening equipment.
3. Discuss three safety precautions to use in grinding.
4. Demonstrate the ability to:
    a. Sharpen plane irons or wood chisels.
    b. Sharpen a twist drill.
    c. Reshape a cold chisel.
    d. Dress a grinding wheel.
    e. Fit a screwdriver.
    f. Replace a hammer handle.

REPAIRING AND SHARPENING TOOLS
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Discuss terminal and specific objectives.

   D. Discuss information sheet.

   E. Demonstrate and discuss procedures outlined in job sheets.

   F. Give test.

II. Student:

   A. Read objectives.

   B. Study information sheet.

   C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objectives

   B. Information sheet

   C. Job sheets

      1. Job Sheet #1--Sharpen Plane Irons or Wood Chisels

      2. Job Sheet #2--Sharpen a Twist Drill

      3. Job Sheet #3--Reshape a Cold Chisel

      4. Job Sheet #4--Dress a Grinding Wheel

      5. Job Sheet #5--Fit a Screwdriver

      6. Job Sheet #6--Replace a Hammer Handle

D. Test

E. Answers to test

II. References:

A. Phipps, Lloyd J. *Mechanics in Agriculture.* Danville, Illinois: Interstate Publishers, 1967.

B. Jones, Mack M. *Shopwork on the Farm.* New York: McGraw-Hill Book Company, Inc., 1955.

REPAIRING AND SHARPENING TOOLS
UNIT I

INFORMATION SHEET

I. Reasons for repairing and sharpening tools

- A. Safety
- B. Good workmanship
- C. Save time

II. Sharpening equipment

- A. Bench grinder
- B. Oilstone
- C. Files
- D. Vise

III. Safety precautions in grinding

- A. Protect eyes and face
    1. Wear goggles or a face shield
    2. Stand slightly to one side so that the face will not be in line with the grinding wheel
    3. Use wheel guards on high-speed power-driven grinders
- B. Adjust work rests
    1. Set work rests as close to the wheel as possible without touching
    2. Too much space may allow the piece being ground to catch and wedge between the wheel and the rest
- C. Adjust bearings
    1. Adjustable bearings should be kept tight and well lubricated
    2. Loose bearings allow vibration and cause inferior grinding

REPAIRING AND SHARPENING TOOLS
UNIT I

JOB SHEET #1--SHARPEN PLANE IRONS OR WOOD CHISELS

I. Tools and equipment

A. Dull plane iron or wood chisel

B. Grinder

C. Oilstone

D. Oil

E. Container of water

II. Procedure

A. Jointing the plane iron

1. Place the iron on the grinder tool rest with the bevel pointing up

2. Hold the iron on the grinder tool rest and touch it lightly against the wheel

3. Move the iron from left to right against the grinder wheel until the nicks are removed

4. Check the edge for squareness

B. Grinding the plane iron

1. Grind the iron at 25° to 30° angles (Figure A)

2. Grind the iron to an angle about 3/16" long

3. Keep the iron perpendicular to the wheel face, and move the iron from side to side until a wire edge appears on the flat side

4. Dip the iron in water often to keep it cool

C. Honing the plane iron or wood chisel

1. Place a few drops of oil on the oilstone

2. Place the flat side of the blade against the oilstone and move the blade back and forth until wire edge is removed (Figure B)

JOB SHEET #1

III. Diagram of the procedure

FIGURE A

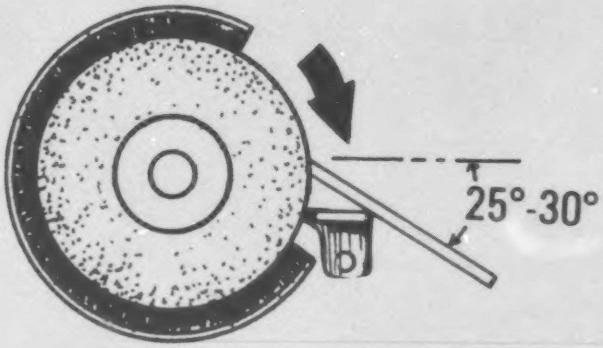
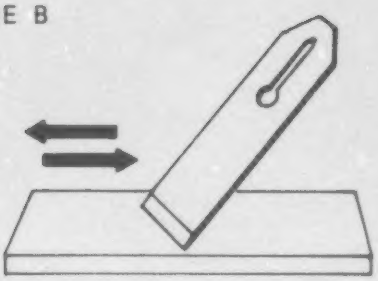


FIGURE B



REPAIRING AND SHARPENING TOOLS
UNIT I

JOB SHEET #2--SHARPEN A TWIST DRILL

I. Tools and equipment

  A. Grinder

  B. Twist drill

  C. Container of water

II. Procedure

  A. Place the drill point against the grinding wheel at approximately a 59° angle (Figure A)

  B. Using both hands, lower the shank, and raise the bit cutting point against the wheel (Figure B)

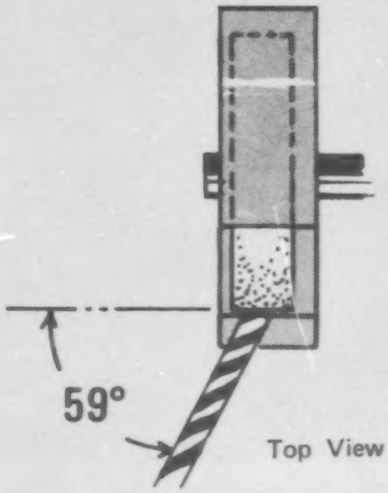
  C. Rotate the bit in a clockwise manner while grinding

  D. Grind both lips in the same manner

  E. Dip the point in water frequently to keep it cool

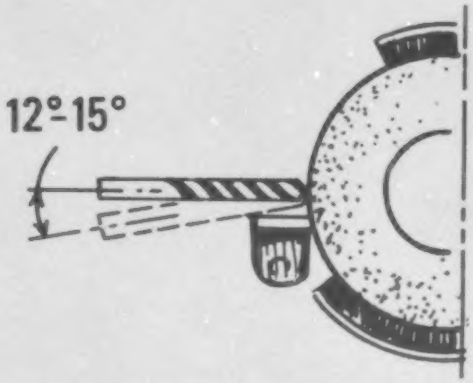
III. Diagram of the procedure

FIGURE A



Top View

FIGURE B



Side View

REPAIRING AND SHARPENING TOOLS
UNIT I

JOB SHEET #3--RESHAPE A COLD CHISEL

I. Tools and equipment

- A. Cold chisel
- B. Grinder
- C. Container of water

II. Procedure

- A. Hold the chisel at a 65° to 70° angle with the handle pointing down (Figure A)
- B. Move the point from side to side across the grinding wheel (Figure B)
- C. Grind both sides of the cutting edge in the same manner (Figure C)
- D. Dip the point in water frequently to keep it cool
- E. If the head has become mushroomed, it should be ground back into shape (Figure D)

III. Diagram of the procedure

FIGURE A

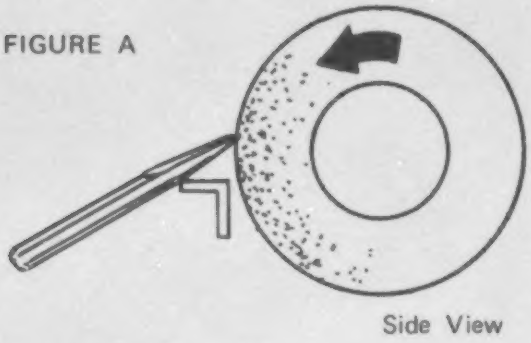


FIGURE B

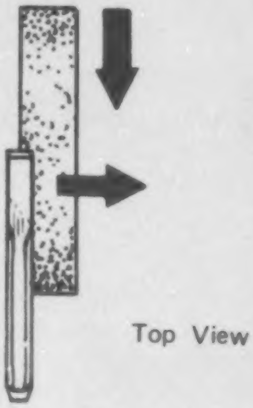


FIGURE C

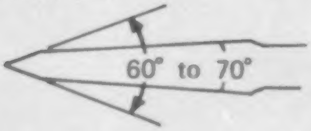
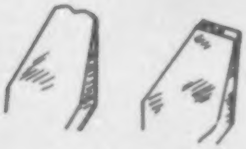


FIGURE D



REPAIRING AND SHARPENING TOOLS
UNIT I

JOB SHEET #4--DRESS A GRINDING WHEEL

I. Tools and equipment

  A. Grinding wheel

  B. Dressing tool

II. Procedure

  A. Select the proper dressing tool

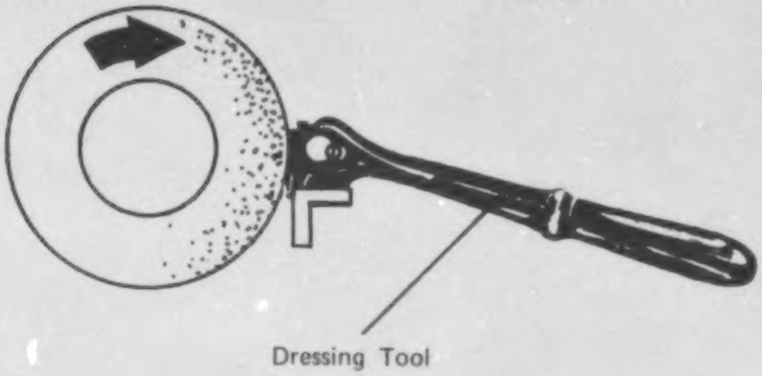
  B. Set the dressing tool on the grinder tool rest and press it firmly against the wheel

  (NOTE: Use enough pressure on the tool to prevent sparks.)

  C. Dress the grinder wheel with the tool until the edges are square with the sides

III. Diagram of the procedure

FIGURE A



REPAIRING AND SHARPENING TOOLS
UNIT I

JOB SHEET #5--FIT A SCREWDRIVER

I. Tools and equipment

   A. Grinder

   B. Screwdriver

   C. Screw with head size equal to the width of the screwdriver's blade

   D. Container of water

II. Procedures

   A. Place screwdriver against the grinder wheel at a 90° angle to square the tip

   B. Apply light pressure on blade, while grinding

   C. Shape both faces of screwdriver (Figure A)

   D. Use screw head to determine the extent of grinding desired

   (NOTE: Do not round or sharpen the end.) (Figure B)

   E. Dip point in water frequently to keep it cool

III. Diagram of the procedure

FIGURE A

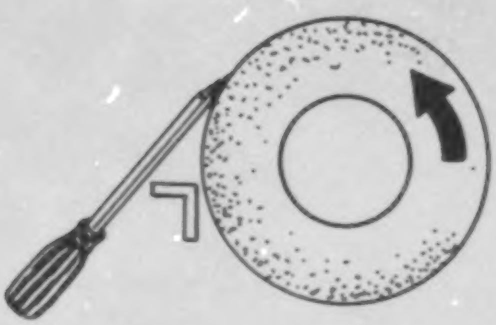
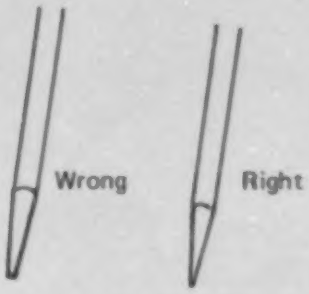


FIGURE B



REPAIRING AND SHARPENING
UNIT I

JOB SHEET #6--REPLACE A HAMMER HANDLE

I. Tools and equipment

A. Hammer with a broken handle

B. Hacksaw

C. Twist drill

D. Punch

E. Rasp

F. Handsaw

G. Soft faced hammer

H. Vise

(NOTE: Cover the jaws of the vise with sheet metal or use wood blocks to prevent damage to the hammer and handle.)

I. New handle

J. Small piece of wood for wedge

II. Procedure

A. Place the hammer head in the vise

B. Saw the broken handle close the hammer head with a backsaw (Figure A)

C. Remove the wood from the eye by first drilling with a twist drill and then punching the remainder out (Figure B)

D. Place the new handle in the vise

E. Work the new handle down to size with a rasp, trying the handle in the head frequently (Figure C)

F. With a handsaw make a cut across the long diameter of the top of the handle to a distance of about 2/3 the depth of the eye (Figure D)

G. Drive the handle firmly into place using a soft faced hammer (Figure E)

JOB SHEET #6

H. Make a thin wooden wedge and drive it tightly into the cut in the end of the handle

I. Place the hammer in the vise and use a hacksaw to cut off the handle and wedge extending through the head (Figure F)

(NOTE: If steel wedges are used, the end of the handle need not be cut across the diameter, as the wedge can be driven into place after the handle has been cut off even with the head.)

III. Diagram of procedure

FIGURE A

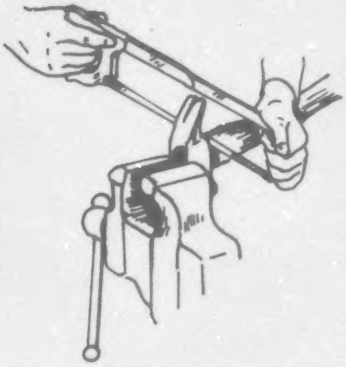


FIGURE B

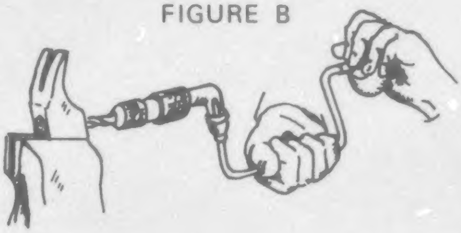


FIGURE C

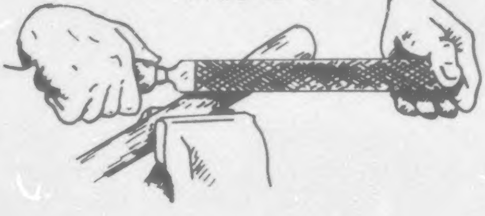


FIGURE D

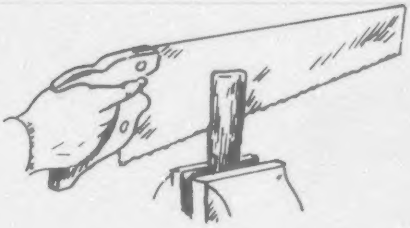


FIGURE E

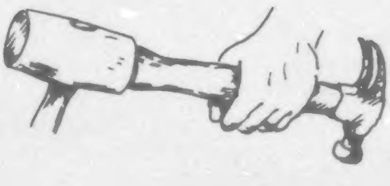
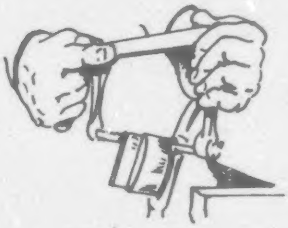


FIGURE F



REPAIRING AND SHARPENING TOOLS
UNIT I

TEST

1. List three reasons for repairing and sharpening tools.

   a.

   b.

   c.

2. List four pieces of sharpening equipment.

   a.

   b.

   c.

   d.

3. Discuss three safety precautions to use in grinding.

   a.

   b.

c.

4. Demonstrate the ability to:
   - a. Sharpen plane irons or wood chisels.
   - b. Sharpen a twist drill.
   - c. Reshape a cold chisel.
   - d. Dress a grinding wheel.
   - e. Fit a screwdriver.
   - f. Replace a hammer handle.

(NOTE: If this has not been accomplished prior to the test, ask the instructor when the above activities should be completed.)

REPAIRING AND SHARPENING TOOLS
UNIT I

ANSWERS TO TEST

1. a. Safety
   b. Good workmanship
   c. Save time
2. a. Bench grinder
   b. Oilstone
   c. Files
   d. Vise
3. The answer should include these points:
   a. Protect eyes and face
      1) Wear goggles or a face shield
      2) Stand slightly to one side so that the face will not be in line with the grinding wheel
      3) Use wheel guards on high-speed power-driven grinders
   b. Adjust work rests
      1) Set work rests as close to the wheel as possible without touching
      2) Too much space may allow the piece being ground to catch and wedge between the wheel and the rest
   c. Adjust bearings
      1) Adjustable bearings should be kept tight and well lubricated
      2) Loose bearings allow vibration and cause inferior grinding
4. Performance skills will be evaluated to the satisfaction of the instructor.

METAL WORK
UNIT II

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to match chisels and threading tools with correct uses, discuss the steps in cutting metal with a hacksaw, and name methods for bending cold metal. He should be able to cut metal with a cold chisel, drill holes with a drill press, and thread nuts and bolts. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match the name of a metal work tool with the correct tool.
2. Match four types of chisels with the correct use of each.
3. Match six threading tools with the correct use of each.
4. Discuss the steps in cutting metal with a hacksaw.
5. Name three methods for bending cold metal.
6. Demonstrate the ability to:
    a. Cut flat metal with a cold chisel.
    b. Drill holes with a drill press.
    c. Thread a nut.
    d. Thread a bolt.

METAL WORK
UNIT II

SUGGESTED ACTIVITIES

I. Instructor:

    A. Provide students with objective sheet.

    B. Provide students with information and job sheets.

    C. Make transparencies.

    D. Discuss terminal and specific objectives.

    E. Discuss information sheet.

    F. Demonstrate and discuss procedures outlined in job sheets.

    G. Give test.

II. Students:

    A. Read objectives.

    B. Study information sheet.

    C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

    D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

    A. Objectives

    B. Information sheet

    C. Transparency masters

        1. TM 1--Metal Measuring Tools

        2. TM 2--Metal Marking Tools

        3. TM 3--Metal Cutting Tools

4. TM 4--Cold Chisels
5. TM 5--Threading Tools
6. TM 6--Cutting Cold Metal With a Hacksaw
7. TM 7--Bending and Shaping Metal

D. Job sheets

1. Job Sheet #1--Cut Flat Metal With a Cold Chisel
2. Job Sheet #2--Drill Holes With a Drill Press
3. Job Sheet #3--Thread a Nut
4. Job Sheet #4--Thread a Bolt

E. Test

F. Answers to test

II. References:

A. Jones, Mark M. *Shopwork on the Farm.* New York: McGraw-Hill Book Company, Inc. 1955.

B. Ross, Henry and R. N. Craig. *Modern Farm Shop.* Austin, Texas: Steck Publishing Company, 1954.

C. Phipps, Lloyd J., H. F. McColly, L. L. Scranton, and G. C. Cook. *Farm Mechanics Text and Handbook.* Danville, Illinois: Interstate Printers and Publishers, 1967.

D. Smith, Robert E. *Bench Metal Work.* Bloomington, Illinois: McKnight and McKnight Publishing Company, 1961.

METAL WORK
UNIT II

INFORMATION SHEET

I. Metal work tools

  A. Measuring tools (Transparency 1)

    1. Steel rule
    2. Combination square
    3. Steel tape
    4. Micrometer

       (NOTE: This is used when a high degree of accuracy is necessary.)

    5. Dividers
    6. Calipers

  B. Marking tools (Transparency 2)

    1. Scratch awl
    2. Scriber
    3. Center punch
    4. Flat file

  C. Cutting tools (Transparency 3)

    1. Hacksaw
    2. Bolt cutter
    3. Cold chisel
    4. Metal shears

II. Types and uses of cold chisels (Transparency 4)

  A. Standard flat--Used to cut sheet metal, bolts, nuts, rivets, and rods

     (NOTE: This is the most common chisel.)

  B. Diamond point--Used for cutting triangular grooves or for marking square corners in grooves

INFORMATION SHEET

- C. Cape--Used to cut rectangular grooves or channels
- D. Round nose--Used for cutting oval grooves or channels

III. Tools for threading bolts and nuts (Transparency 5)

- A. Taps--Used for cutting threads in nuts or on the inside of holes drilled in metal
    1. Taper tap--Used to start all threads and may be used to complete the operation when the tap can be run entirely through the piece of metal
    2. Plug tap- Used when one end of the hole is closed
    3. Bottoming tap--Used when it is necessary to cut a full thread to the bottom of the hole

  (NOTE: Plug or bottoming taps should not be used to start a thread.)

- B. Dies--Used for cutting threads on bolts
- C. Die stock--Used for holding dies in position while cutting a thread
- D. Tap wrench--Used to turn the tap while cutting a thread

IV. Steps in cutting metal with a hacksaw (Transparency 6)

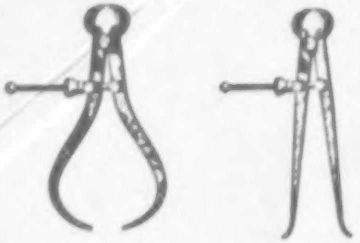
- A. Mark the point
- B. Place metal in vise
- C. Notch the mark with a file
- D. Cut
    1. Use long strokes
    2. Apply pressure on forward stroke
    3. Reduce pressure on backward stroke
    4. Use 40-60 strokes per minute

V. Methods for bending cold metal (Transparency 7)

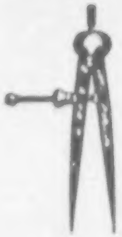
- A. Use a hammer and an anvil
- B. Use a hammer and a vise
- C. Use a metal bending fork and a vise
- D. Use a piece of pipe, a rod, and a vise
- E. Use a vise and a wrench to twist square rod

Metal Measuring Tools

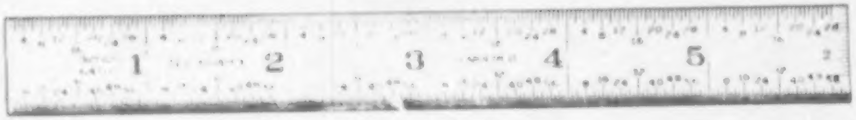
Calipers



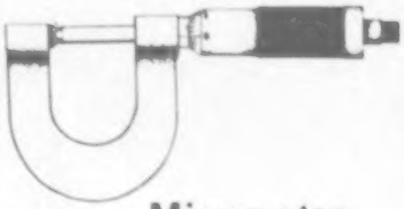
outside inside



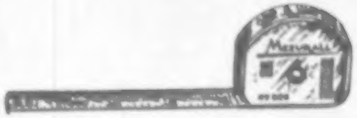
Dividers



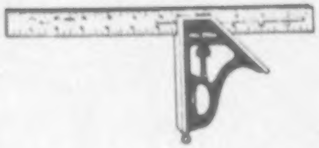
Steel Rule



Micrometer

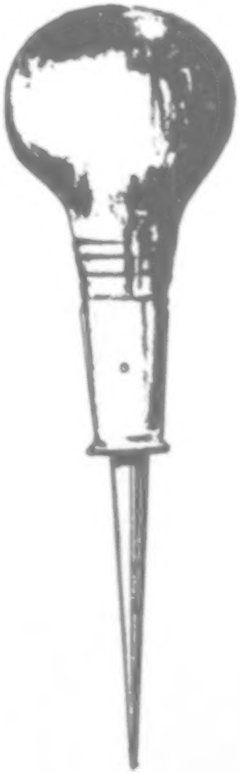


Steel Tape

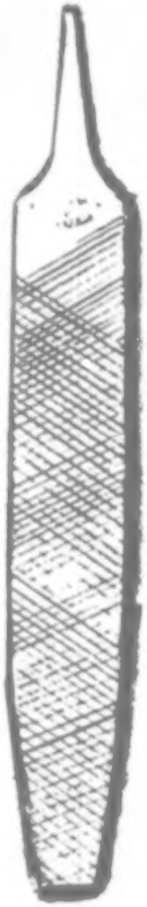


Combination Square

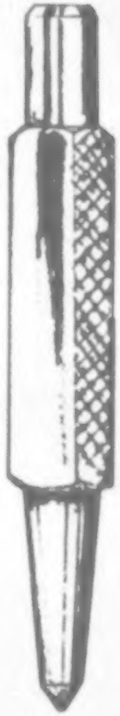
Metal Marking Tools



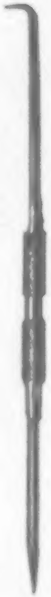
Scratch Awl



Flat File



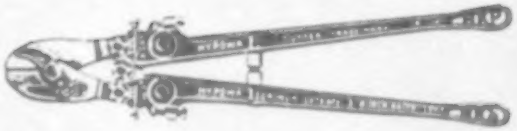
Center Punch



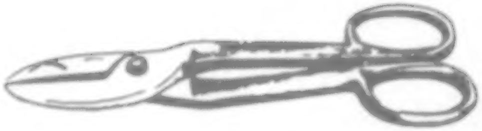
Scriber

Metal Cutting Tools

Hacksaw



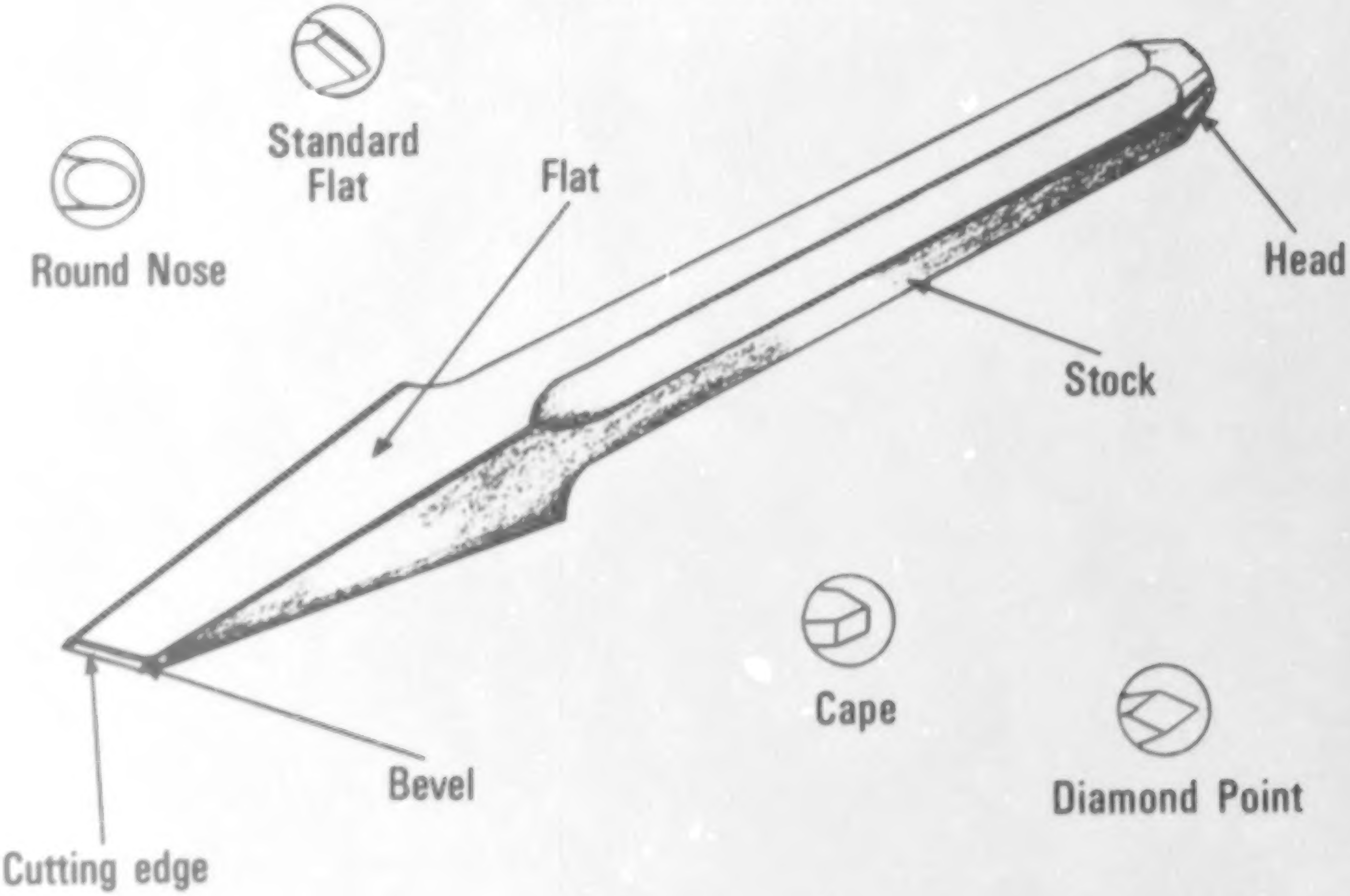
Bolt Cutter



Metal Shears

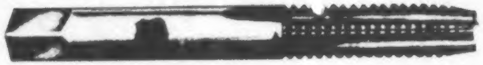
Cold Chisel

Cold Chisels


Standard
Flat
Round Nose
Flat
Head
Stock
Cape
Diamond Point
Bevel
Cutting edge

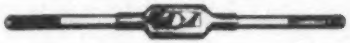
Threading Tools

Taper Tap

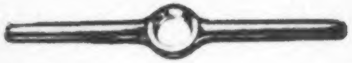


Plug Tap

Bottoming Tap

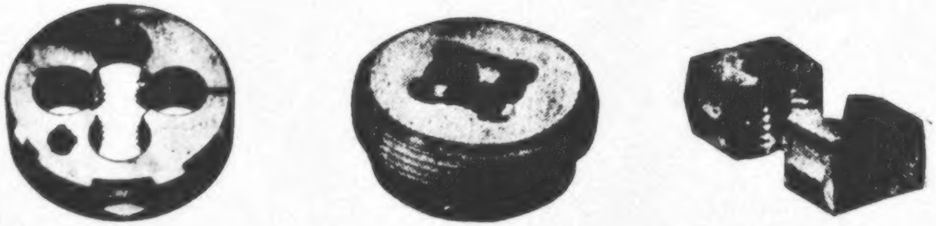


Tap Wrench

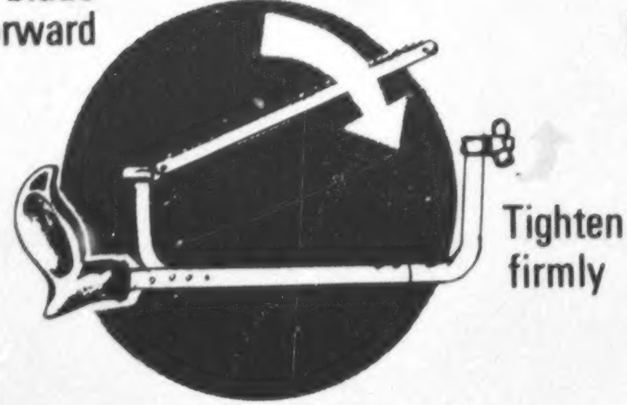


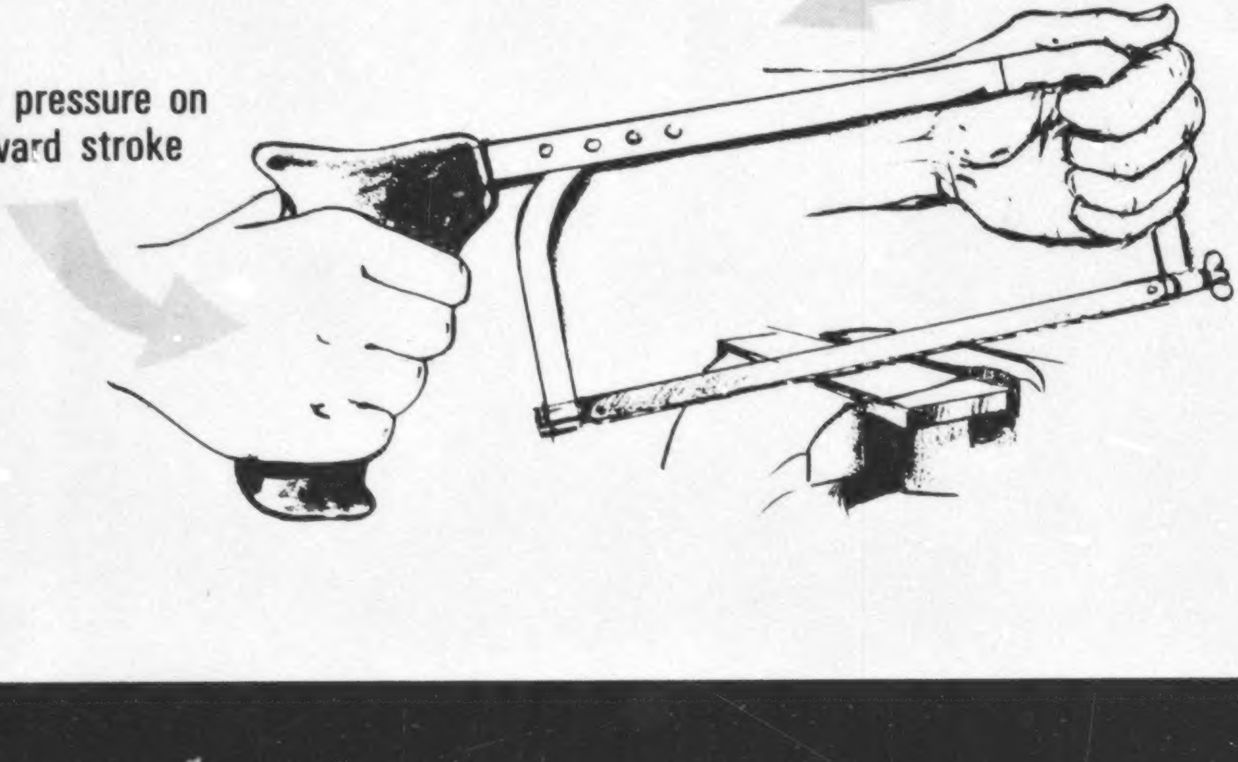
Die Stock

Dies

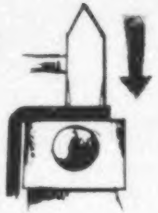


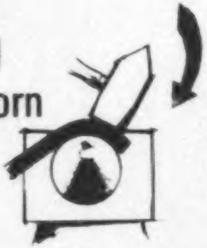
Cutting Cold Metal with a Hacksaw

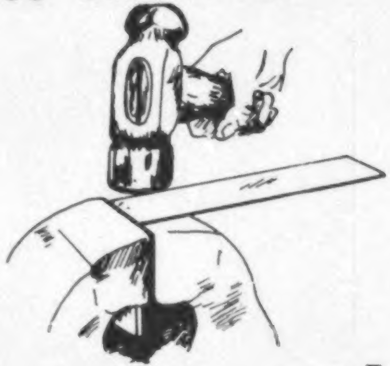

Insert blade teeth forward
Tighten firmly

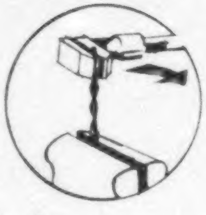

No pressure on back stroke
Use pressure on forward stroke

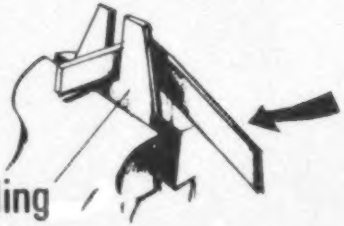
Bending and Shaping Metal

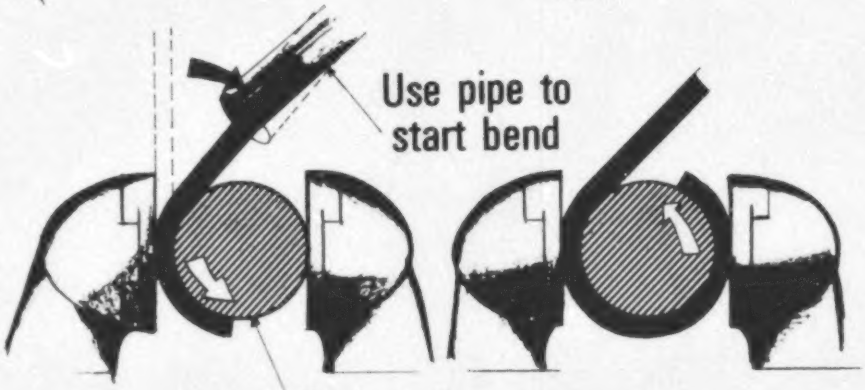

90° bend on anvil


Shape end on anvil horn


90° Bend in vise


Twisting square rod


Bending fork


Use pipe to start bend

Rod

METAL WORK
UNIT II

JOB SHEET #1--CUT FLAT METAL WITH A COLD CHISEL

I. Tools and equipment

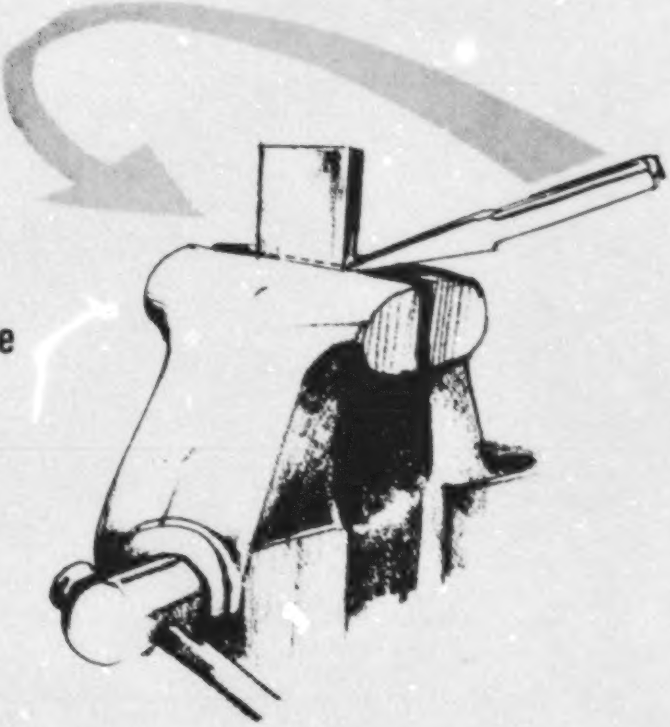
- A. Marker (oval, chalk, etc.)
- B. Flat strip of metal
- C. Chisel
- D. Hammer
- E. Vise
- F. Safety goggles

II. Procedure

- A. Mark the metal
- B. Place the metal in the vise with the cutting mark just above the jaws of the vise
- C. Select proper size chisel and hammer (For larger size metal, use a larger chisel and hammer.)
- D. Place the chisel at side of the metal to start the shearing point (Drive the chisel with a hammer.)
- E. Hold the chisel at approximately a 60° angle
- F. Make cuts from each end of the metal to the center and on both sides
- G. Bend metal back and forth until it breaks

JOB SHEET #1

III. Diagram of the procedure



Repeat cut on opposite side

METAL WORK
UNIT II

JOB SHEET #2--DRILL HOLES WITH A DRILL PRESS

I. Tools and equipment

  A. Small piece of flat metal

  B. Drill press

  C. Center punch

  D. Hammer

  E. Wooden block

  F. Cutting oil

  G. Clamp

  H. Safety goggles

II. Procedure

  A. Mark the hole with a center punch

  B. Place the metal on a wooden block

  C. Clamp the metal being drilled securely to prevent it from spinning

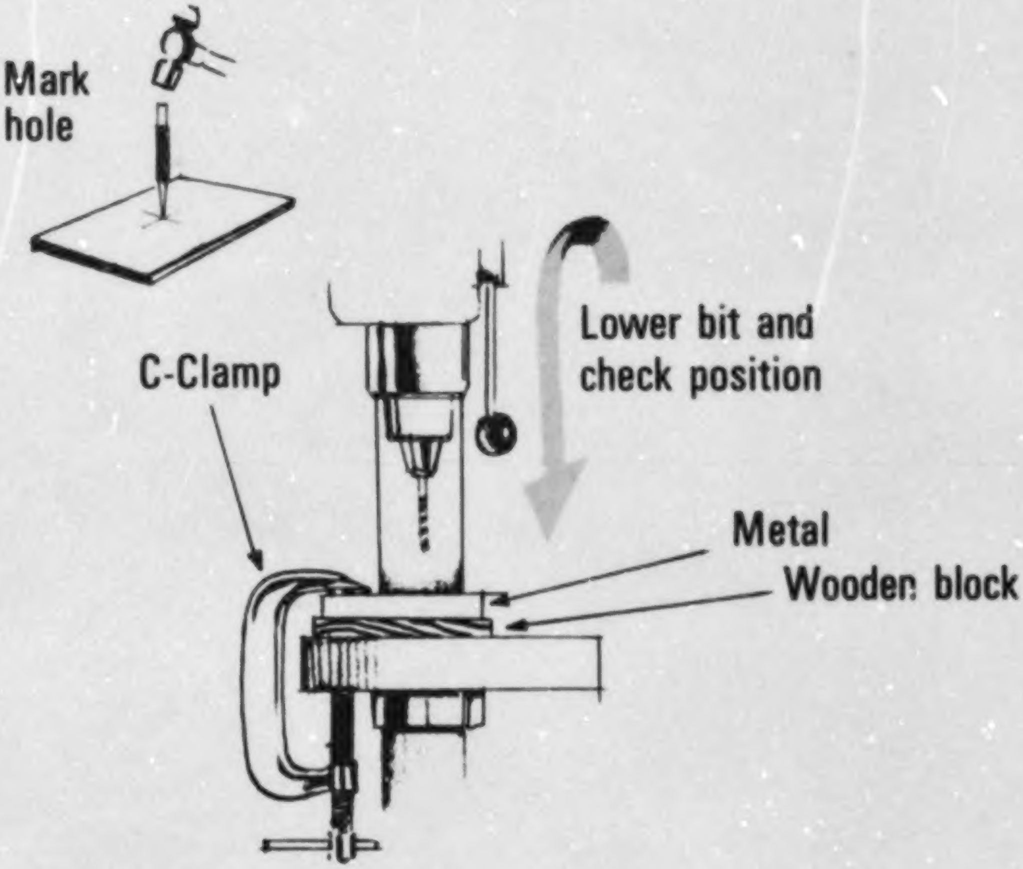
  D. Feed the bit down to the metal and start drilling

  E. Raise the bit to see if you are drilling in the proper place

  F. Continue drilling, using cutting oil on the drill bit two or three inches above the work

JOB SHEET #2

II. Diagram of the procedure


Mark hole
Lower bit and check position
C-Clamp
Metal
Wooden block

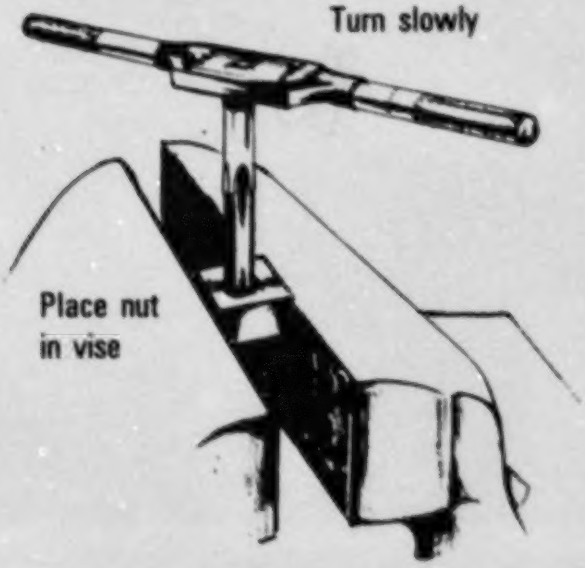
METAL WORK
UNIT II

JOB SHEET #3--THREAD A NUT

I. Tools and equipment
  A. Nut with a hole bored through it
  B. Vise
  C. Tap
  D. Cutting oil

II. Procedure
  A. Place nut in a vise firmly, but do not overtighten
  B. Select proper tap
  C. Place tap up and down over hole and turn tap slowly
  D. Apply cutting oil
  E. Remove tap by turning to the left when threads are completed

III. Diagram of the procedure



METAL WORK
UNIT II

JOB SHEET #4--THREAD A BOLT

I. Tools and equipment

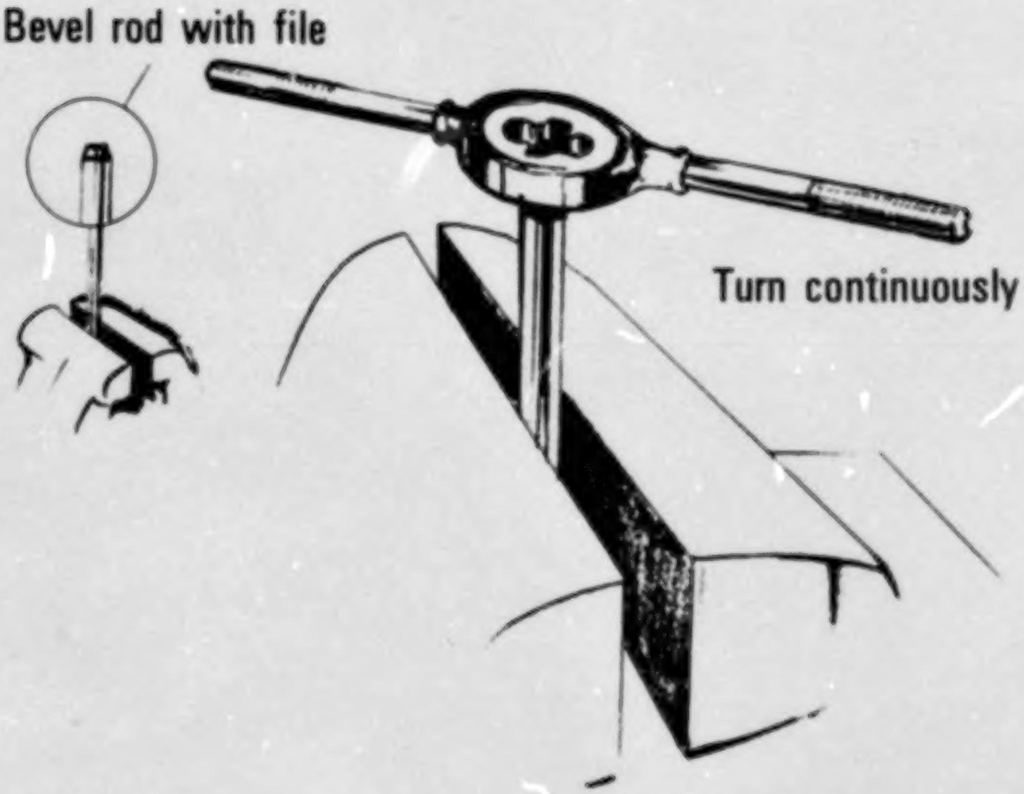
- A. Short piece of rod to be used as a bolt
- B. Flat file
- C. Die
- D. Vise
- E. Cutting oil
- F. Wire brush

II. Procedure

- A. Place rod in a perpendicular position in the vise
- B. Bevel the end to be threaded
- C. Select proper size of die and handle
- D. Place the die squarely on the bolt
- E. Apply cutting oil
- F. Turn continuously in one direction until finished
- G. Remove the die by turning it to the left

JOB SHEET #4

III. Diagram of the procedure


Bevel rod with file
Turn continuously

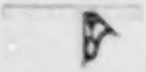
METAL WORK
UNIT II

TEST

1. Match the name with the correct tool.

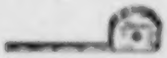
1. Bolt cutter
2. Center punch
3. Cold chisel
4. Combination square
5. Dividers
6. Flat file
7. Hacksaw
8. Inside calipers
9. Metal shears
10. Micrometer
11. Outside calipers
12. Scratch awl
13. Scriber
14. Steel rule
15. Steel tape

________ a.

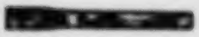


________ b.

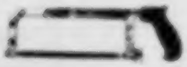
________ c.



________ d.



________ e.



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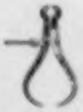
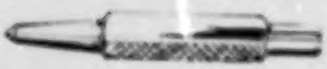


________ g.

________ h.



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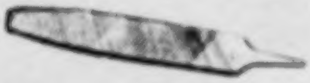
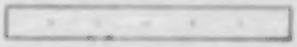


________ j.



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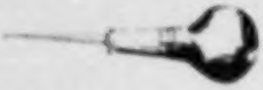
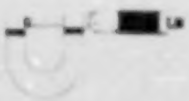
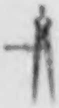


________ l.



________ m.



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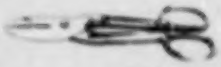
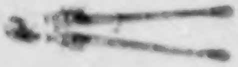


________ o.



2. Match the chisels on the right with the correct use of each.

_____ a. Cuts triangular grooves	1. Diamond point
_____ b. Cuts oval grooves	2. Cape
_____ c. Cuts rectangular grooves	3. Standard flat
_____ d. Cuts sheet metal, bolts, nuts, rivets, and rods	4. Round nose

3. Match the threading tools on the right with the correct use of each.

_____ a. Starts all threads on the inside of holes drilled in metal	1. Bottoming tap 2. Dies
_____ b. Cuts threads on the inside when one end of the hole is closed	3. Die stock 4. Plug tap
_____ c. Cuts threads on the inside when it is necessary to cut a full thread to the bottom of the hole	5. Taper tap 6. Tap wrench
_____ d. Cuts threads on bolts	
_____ e. Holds tool for cutting threads inside a hole drilled in metal	
_____ f. Holds tool for cutting threads on bolts	

4. Discuss in a paragraph the steps in cutting metal with a hacksaw

5. Name three methods for bending cold metal.

   a.

   b.

   c.

6. Demonstrate the ability to:

   a. Cut flat metal with a cold chisel.

   b. Drill holes with a drill press.

   c. Thread a nut.

   d. Thread a bolt.

   (NOTE: If this has not been accomplished prior to the test, ask the instructor when the above activities should be completed.)

METAL WORK
UNIT II

ANSWERS TO TEST

1. a. 4
   b. 13
   c. 15
   d. 3
   e. 7
   f. 11
   g. 8
   h. 2
   i. 6
   j. 14
   k. 12
   l. 10
   m. 5
   n. 9
   o. 1
2. a. 1
   b. 4
   c. 2
   d. 3
3. a. 5
   b. 4
   c. 1
   d. 2

   e. 6

   f. 3

4. Discussion should include these points:

   a. Mark the point

   b. Place metal in vise

   c. Notch the mark with a file

   d. Cut

      1) Use long strokes

      2) Apply pressure on forward stroke

      3) Reduce pressure on backward stroke

      4) Use 40-60 strokes per minute

5. Any three of the following:

   a. Use a hammer and an anvil

   b. Use a hammer and a vise

   c. Use a metal bending fork and a vise

   d. Use a piece of pipe, a rod, and a vise

   e. Use a vise and a wrench to twist square rod

6. Performance skills will be evaluated to the satisfaction of the instructor.

SOLDERING
UNIT III

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to identify the types of solder, name fluxes, and identify soldering devices. He should be able to name safety rules for soldering and demonstrate the ability to tin a soldering iron and solder a lap joint. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match six terms and definitions associated with soldering.
2. Identify three types of solder.
3. Name three fluxes.
4. Identify five soldering devices.
5. Name four safety rules to follow when soldering.
6. Demonstrate the ability to:
    a. Tin a soldering iron.
    b. Solder a lap joint.
    c. Sweat solder a lap joint.

SOLDERING
UNIT III

SUGGESTED ACTIVITIES

I. Instructor:
   - A. Provide students with objective sheet.
   - B. Provide students with information and job sheets.
   - C. Discuss terminal and specific objectives.
   - D. Discuss information sheet.
   - E. Demonstrate and discuss procedures outlined in job sheets.
   - F. Give test.

II. Student:
   - A. Read objectives.
   - B. Study information sheet.
   - C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.
   - D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:
   - A. Objectives
   - B. Information sheet
   - C. Transparency masters
     1. TM 1--Types of Solder
     2. TM 2--Soldering Devices
   - D. Job sheets
     1. Job Sheet #1--Tin a Soldering Iron
     2. Job Sheet #2--Solder a Lap Joint
     3. Job Sheet #3--Sweat Solder a Lap Joint

E. Test

B. Answers to test

II. References:

A. Walker, John R. *Modern Metalworking.* South Holland, Illinois: The Goodheart-Willcox Company, Inc., 1970.

B. Ludwig, Oswald A. and Willard J. McCarthy. *Metalwork Technology and Practice.* Bloomington, Illinois: McKnight and McKnight Publishing Company, 1969.

C. Boyd, T. Gardner. *Metalworking.* Homewood, Illinois: The Goodheart-Willcox Company, Inc., 1964.

D. Phipps, Lloyd J. *Mechanics in Agriculture.* Danville, Illinois: Interstate Publishers, 1967.

SOLDERING
UNIT III

INFORMATION SHEET

I. Terms and definitions

   A. Solder--A metal alloy commonly made up of tin and lead

   B. Soldering--The process of uniting two pieces of metal by means of a metal alloy having a lower melting point than the metals to be joined

   C. Flux--The substance used to clean the surface to be soldered or tinned

   D. Soldering iron--The device used for melting and applying the solder

   E. Tinning--The coating of the four faces of the soldering iron with solder

   F. Sweat soldering--A process where heat is applied to the pieces to be joined and the solder is melted

II. Types of solder (Transparency 1)

   A. Solid wire

   B. Acid or rosin core wire

   C. Bar

III. Fluxes

   A. Zinc chloride

   B. Rosin

   C. Muriatic acid

   D. Sal ammoniac

IV. Soldering devices (Transparency 2)

   A. Non-electric soldering iron (soldering copper)

   B. Electric soldering iron

   C. Electric soldering gun

   D. Gas torch

   E. Welder

   (NOTE: Short carbon against the metal to heat the area for soldering.)

INFORMATION SHEET

V. Safety rules

  A. Store soldering iron carefully after use as improper storage can result in serious burns or a fire

  B. Wash hands thoroughly after using soft solder

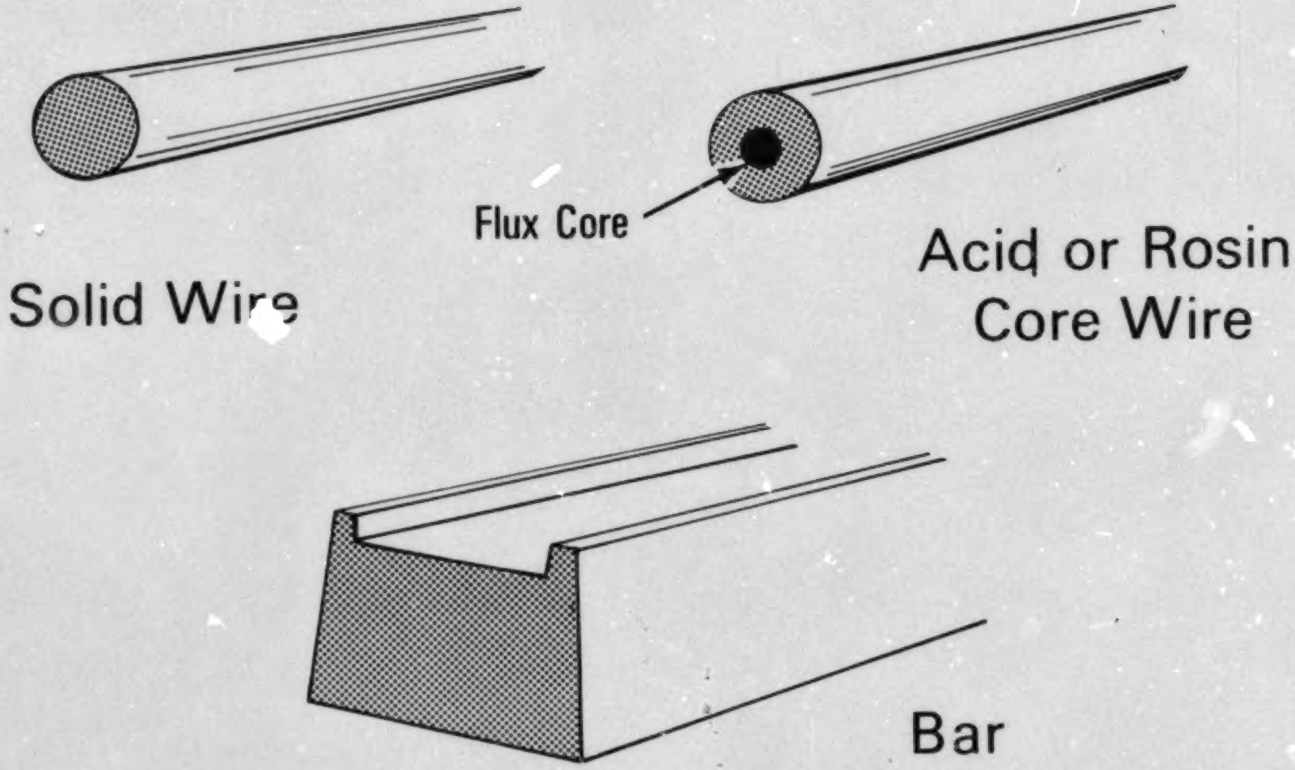
  C. Protect eyes from splattering solder and flux

  D. Have cuts and burns treated promptly

  E. Tin the soldering iron in a well-ventilated area

  F. Do not touch joints that have just been soldered

Types of Solder

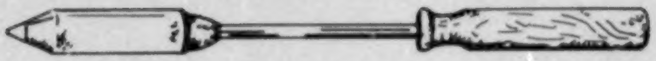


Solid Wire

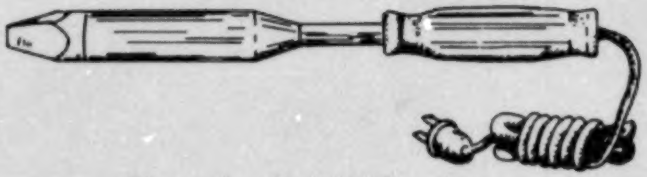
Acid or Rosin
Core Wire

Bar

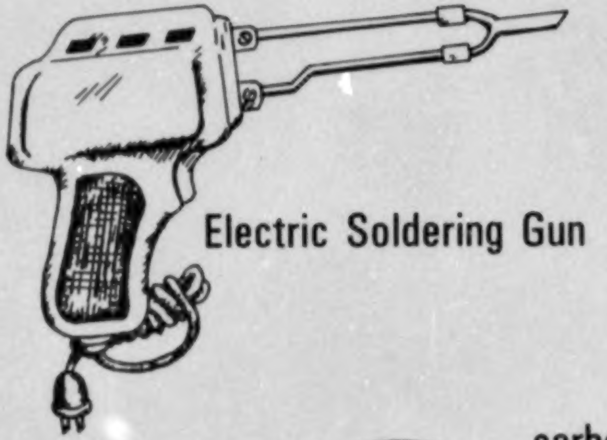
Soldering Devices



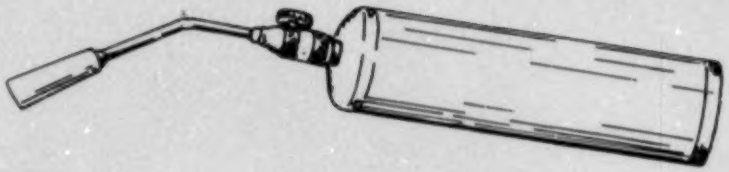
Non-Electric Soldering Iron
(Soldering Copper)



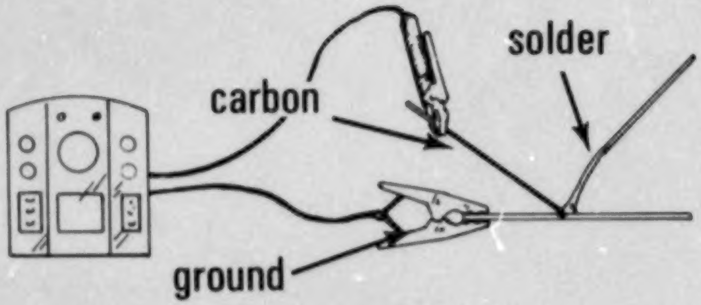
Electric Soldering Iron



Electric Soldering Gun



Gas Torch


solder
carbon
ground

Welder with Carbon

SOLDERING
UNIT III

JOB SHEET #1–TIN A SOLDERING IRON

I. Tools and equipment

   A. Soldering iron

   B. File

   C. Zinc chloride or sal ammoniac or powdered rosin

   D. Solder

   E. Gas furnace or torch (if a non-electric iron is being used)

   F. Clean cloth

II. Procedures

   A. Clean the four faces of the point with a file

   (NOTE: This is necessary for removing rough spots from copper.)

   B. Heat the iron until it will melt solder

   C. Continue with one of the following three ways depending on materials available

      1. Zinc chloride

         a. Dip point quickly into and out of a jar zinc chloride

         b. Melt solder on the faces

         c. Wipe with a clean cloth to remove excess solder

      2. Sal ammoniac

         a. Drop a few drops of solder on the sal ammoniac block

         b. Rub the tip in the drops on the block

         c. Remove excess solder by wiping the tip with a clean cloth

      3. Rosin

         a. Rub the tip in powdered rosin

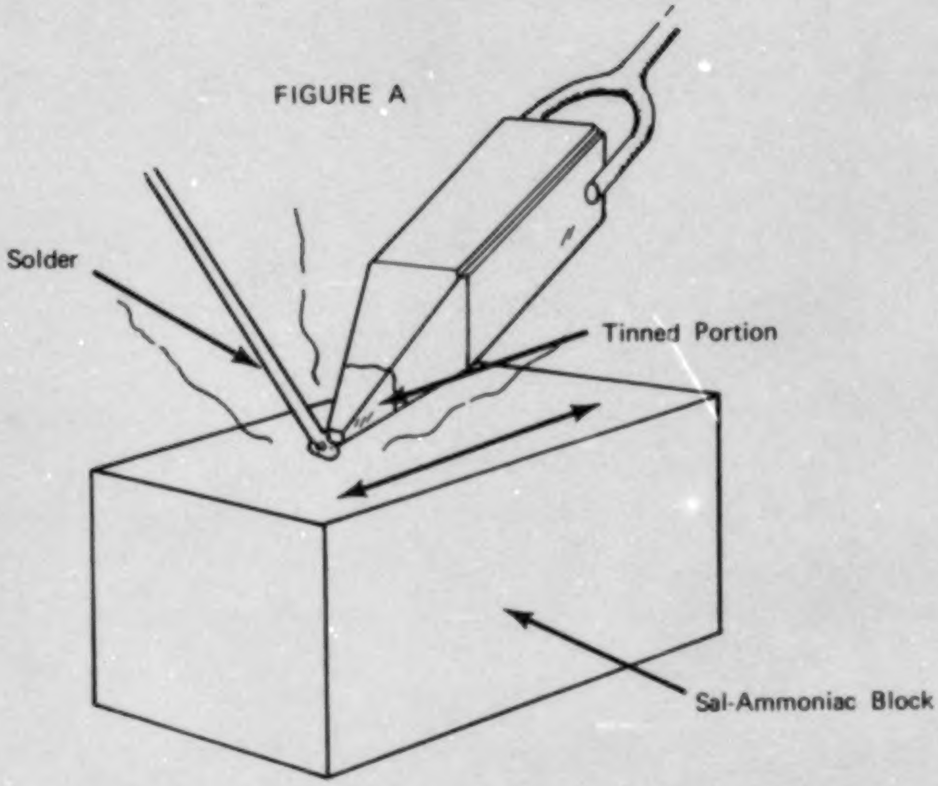
         b. Dip the tip in solder

         c. Wipe with a clean cloth to remove excess solder

JOB SHEET #1

III. Diagram of procedure

FIGURE A


Solder
Tinned Portion
Sal-Ammoniac Block

Tinning a Soldering Iron on a Sal-Ammoniac Block.

SOLDERING
UNIT III

JOB SHEET #2--SOLDER A LAP JOINT

I. Tools and equipment

- A. Soldering iron
- B. Solder
- C. Flux
- D. File
- E. Water

II. Materials--Two pieces of sheet metal 2" x 6"

III. Procedures

- A. Clean the area to be soldered
- B. Apply flux (Figure A)
- C. Clean, heat, and tin the soldering iron

  (NOTE: Never let it become red hot.)

- D. Hold the seam together and tack it with small amounts of solder at several points (Figure B)

  (NOTE: Apply the solder directly in front of the soldering iron tip rather than on it.)

- E. Return to the starting point; with the soldering iron flat on the work and with the seam pressed together with a file tang, start moving the soldering iron slowly toward the end of the joint as soon as the solder melts and begins to flow (Figures C and D)

  (NOTE: As the soldering iron advances, follow it with the file tang as soon as the solder hardens.)

- F. Clean the seam with water

  (NOTE: This only needs to be done if an acid flux such as zinc chloride, sal ammoniac, or other acid is used. The joint and the metal touched by the flux will turn black if this is not done.)

JOB SHEET #2

IV. Diagram of procedure

FIGURE A

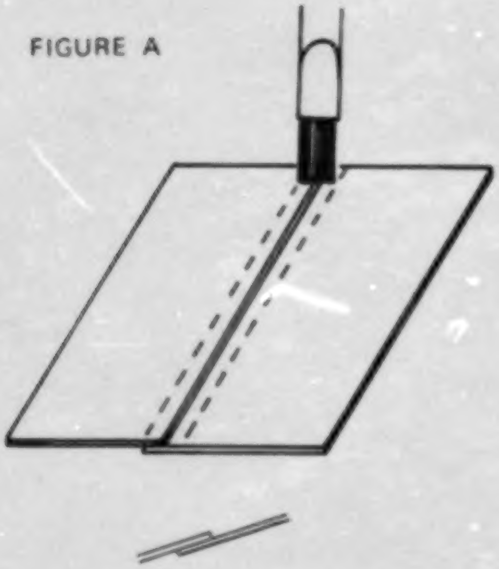


FIGURE B

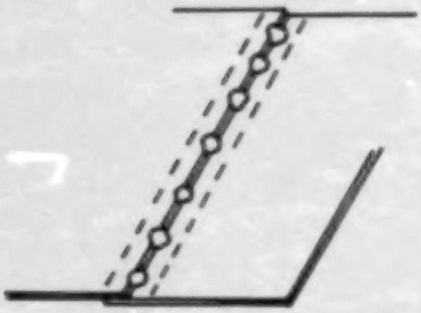
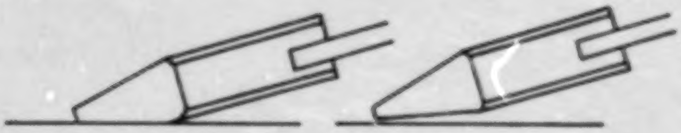


FIGURE C



Proper

Improper

Use of Soldering Iron

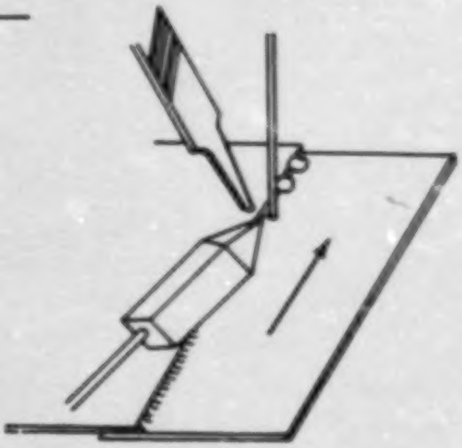


FIGURE D

SOLDERING
UNIT III

JOB SHEET #3--SWEAT SOLDER A LAP JOINT

I. Tools and equipment

   A. Soldering iron

   B. Solder

   C. Flux

   D. Clamps

II. Materials--Two pieces of sheet metal 2" x 6"

III. Procedure

   A. Clean the surfaces of metal

   B. Apply flux

   C. Coat each surface with a thin layer or coating of solder

   D. Clamp the prepared pieces together

   E. Apply heat until the solder melts and joins the pieces together

   (NOTE: Sweat soldering is done when two or more pieces must be joined and no solder is to be seen after the soldering is completed.)

SOLDERING
UNIT III

TEST

1. Match these terms with the correct definition.

_____a. A metal alloy commonly made of tin and lead

_____b. The process of uniting two pieces of metal by means of a metal alloy having a lower melting point than the metals to be joined

_____c. The substance used to clean the surface to be soldered or tinned

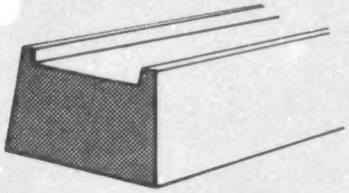
_____d. The device used for melting and applying the solder

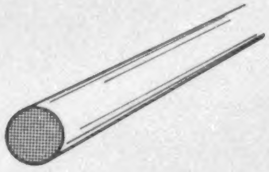
_____e. The coating of the four faces of the soldering iron with solder

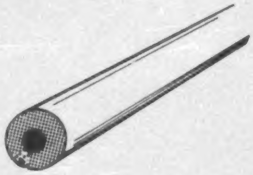
_____f. A process where heat is applied to the pieces to be joined and the solder is melted

1. Flux
2. Solder
3. Soldering
4. Soldering iron
5. Sweat soldering
6. Tinning

2. Identify these types of solder.







a. ____________________ b. ____________________ c. ____________________

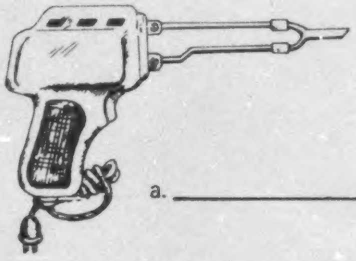
3. Name three fluxes.

   a.

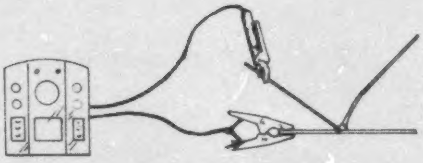
   b.

   c.

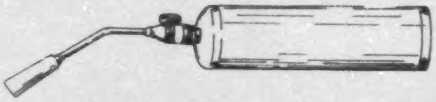
4. Identify these soldering devices.



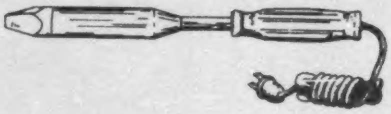
a. ______________________



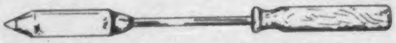
b. ______________________



c. ______________________



d. ______________________



e. ______________________

5. Name four safety rules to follow when soldering.

   a.

   b.

   c.

   d.

6. Demonstrate the ability to:

   a. Tin a soldering iron.

   b. Solder a lap joint.

   c. Sweat solder a lap joint.

   (NOTE: If this has not been accomplished prior to the test, ask the instructor when the above activities should be completed.)

SOLDERING
UNIT III

ANSWERS TO TEST

1. a. 2
   b. 3
   c. 1
   d. 4
   e. 6
   f. 5
2. a. Bar
   b. Solid wire
   c. Acid or rosin core wire
3. Any three of the following:
   a. Zinc chloride
   b. Rosin
   c. Muriatic acid
   d. Sal ammoniac
4. a. Electric soldering gun
   b. Welder
   c. Gas torch
   d. Electric soldering iron
   e. Non-electric soldering iron (soldering copper)
5. Any four of the following:
   a. Store soldering iron carefully after use as improper storage can result in serious burns or a fire
   b. Wash hands thoroughly after using soft solder

   c. Protect eyes from splattering solder and flux

   d. Have cuts and burns treated promptly

   e. Tin the soldering iron in a well-ventilated area

   f. Do not touch joints that have just been soldered

6. Performance skills will be evaluated to the satisfaction of the instructor.